

MOORED OBSERVATIONS OF INTERNAL SOLITONS IN THE NORTHEASTERN SOUTH CHINA SEA



By

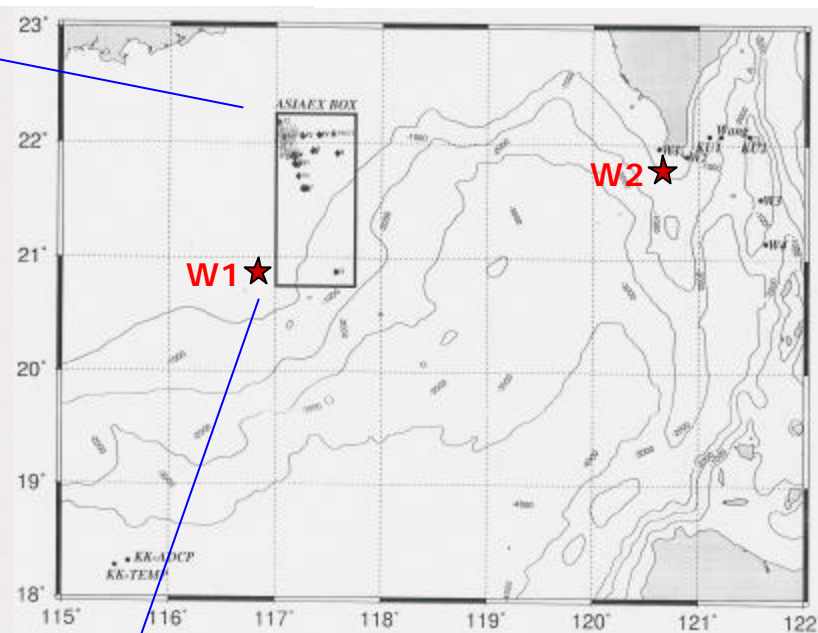
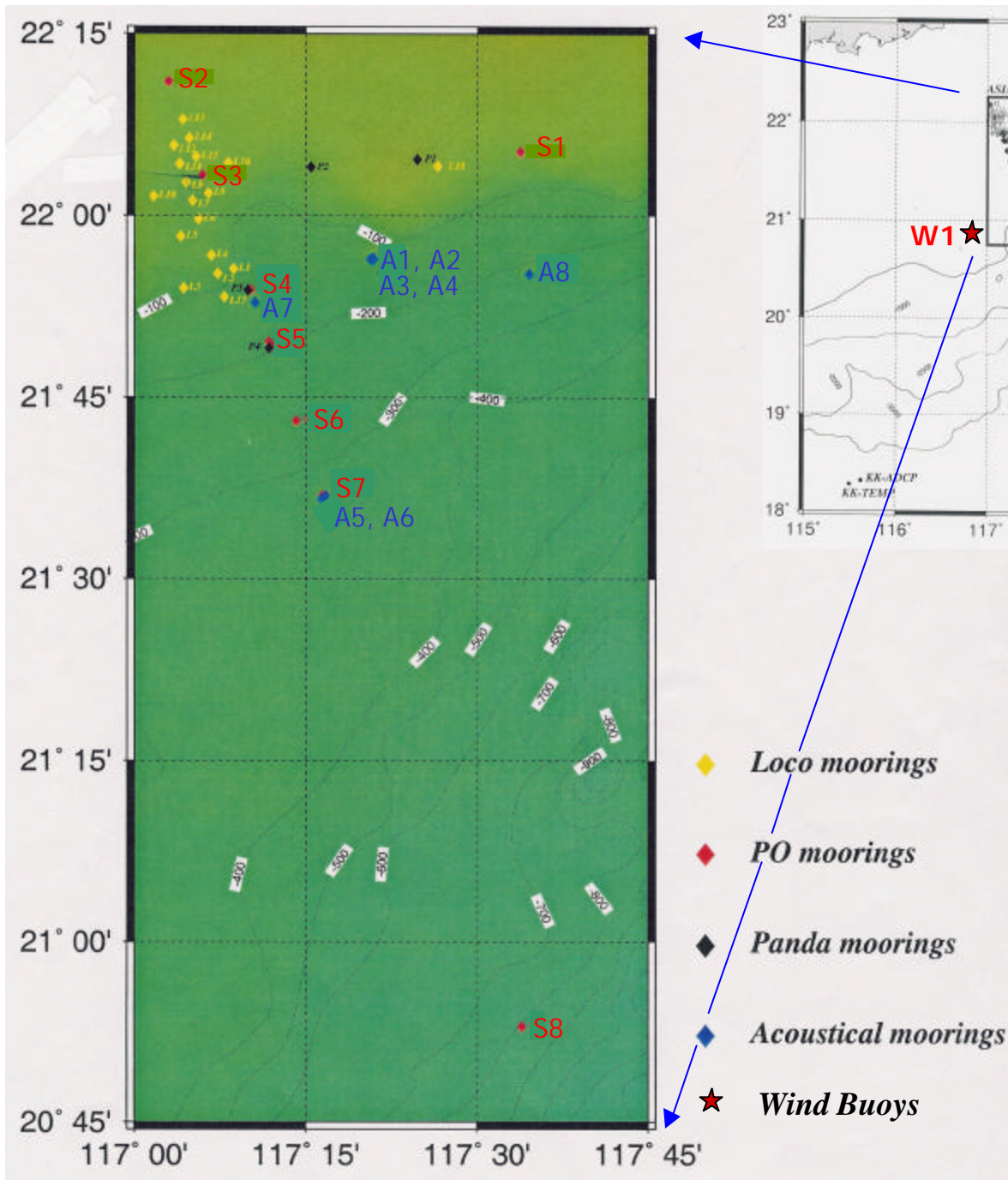


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David Tang, Jim Lynch, Ching-Sang Chiu, Tim
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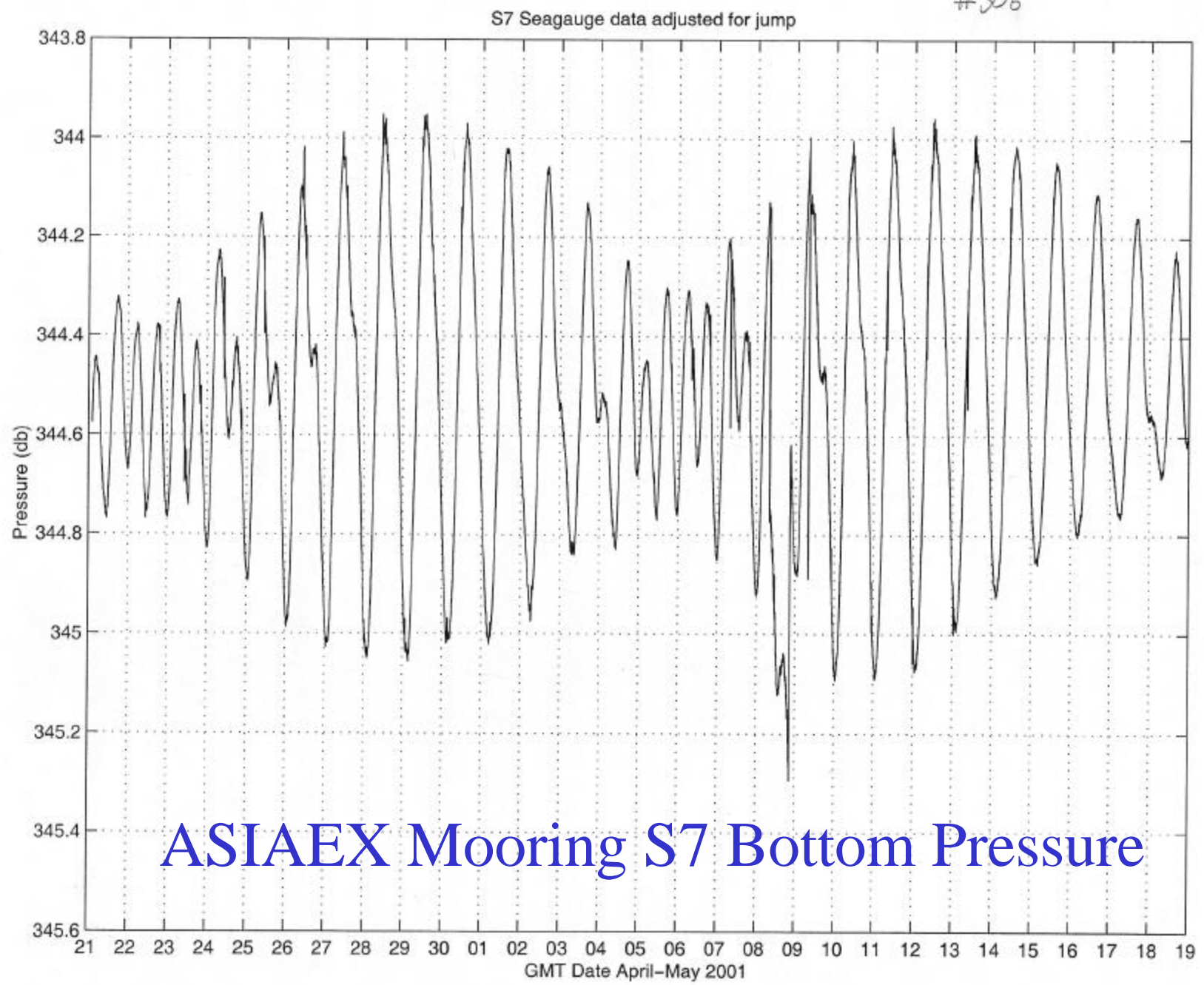
ASIAEX

Mooring Positions

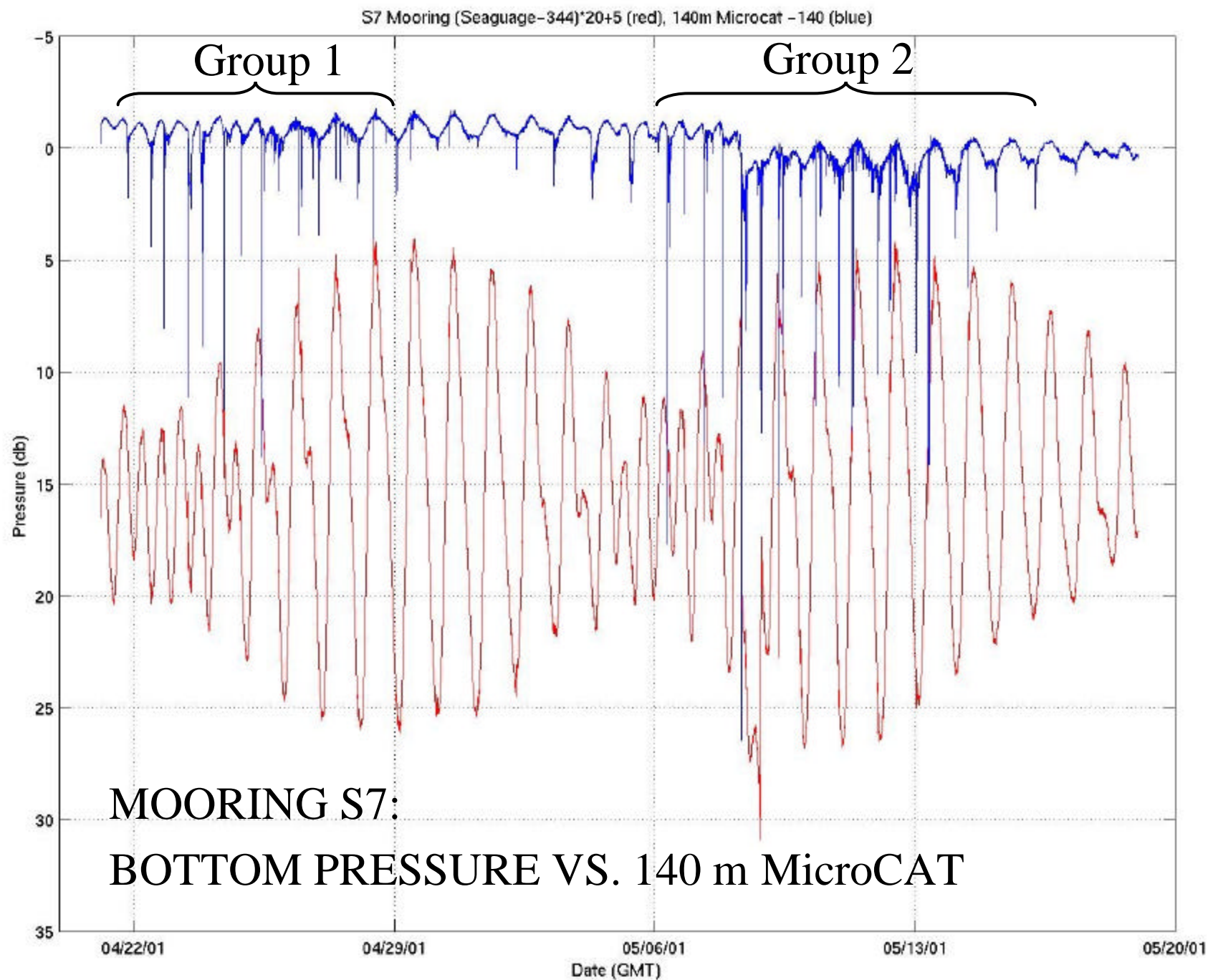
April – May 2001

Base graphic courtesy of David Tang,
National Taiwan University

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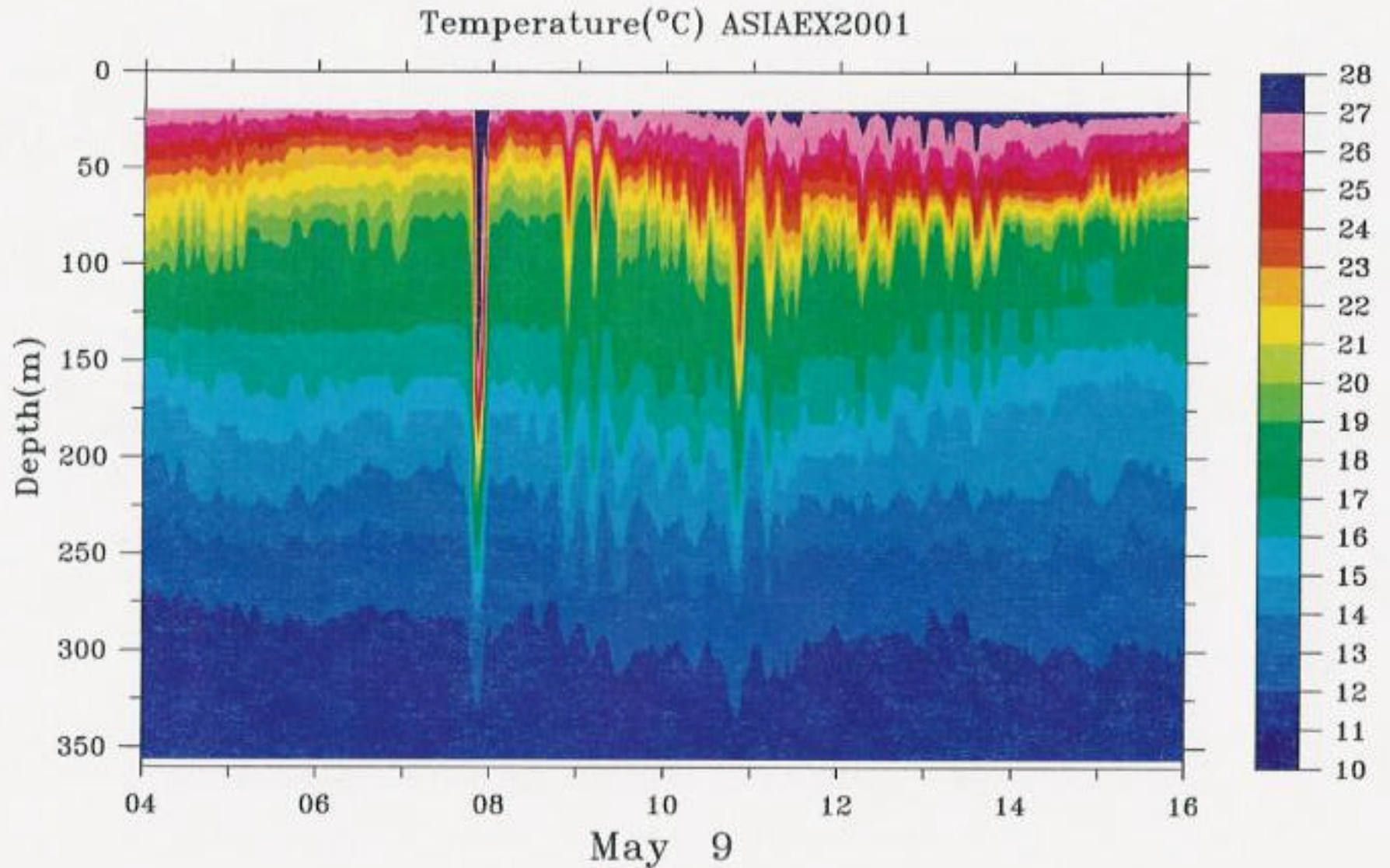


ASIAEX Mooring S7 Bottom Pressure



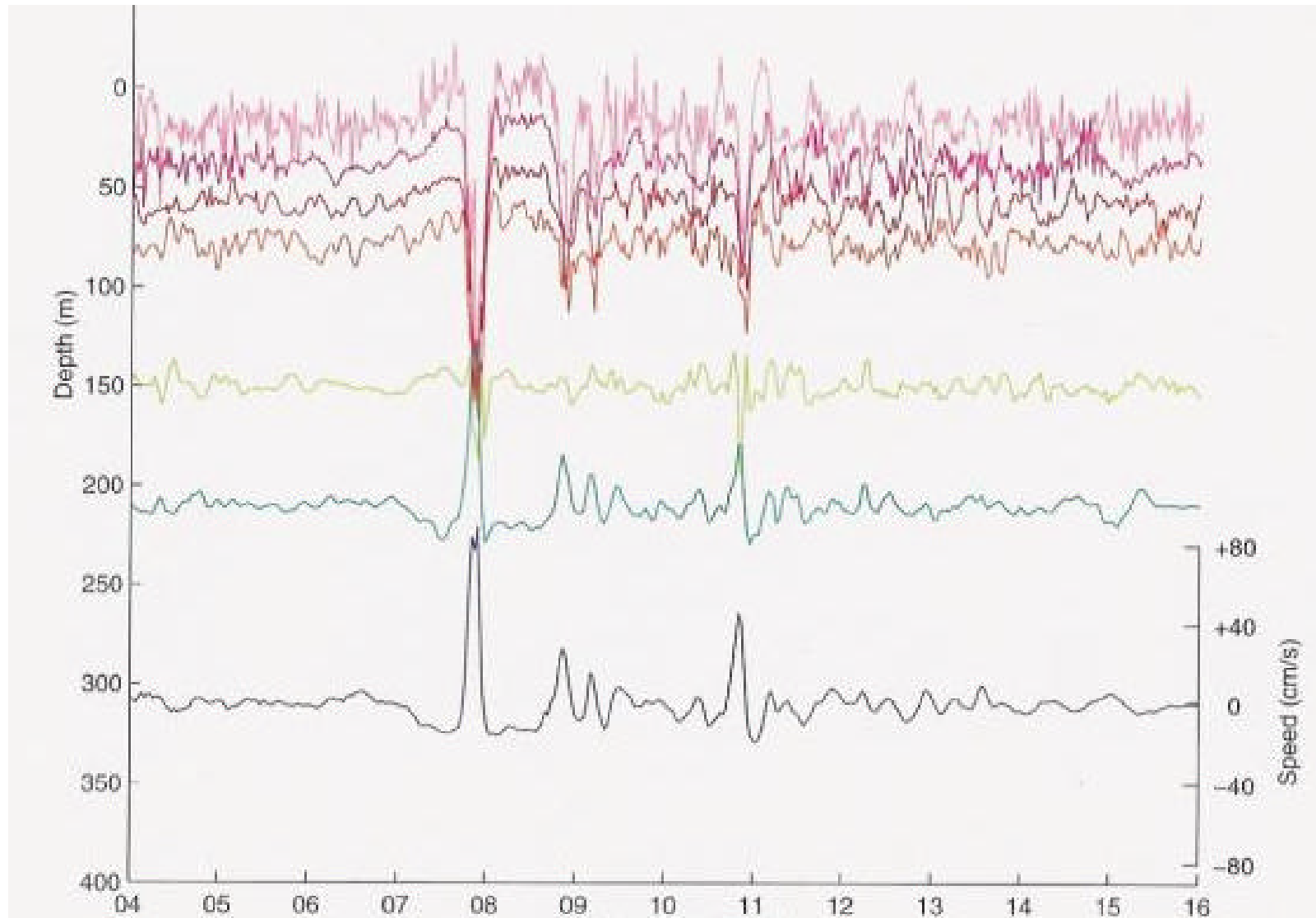
A Sample Wave

ASIAEX MOORING S7 (350 m) TEMPERATURE



MOORING S7 u-VELOCITY

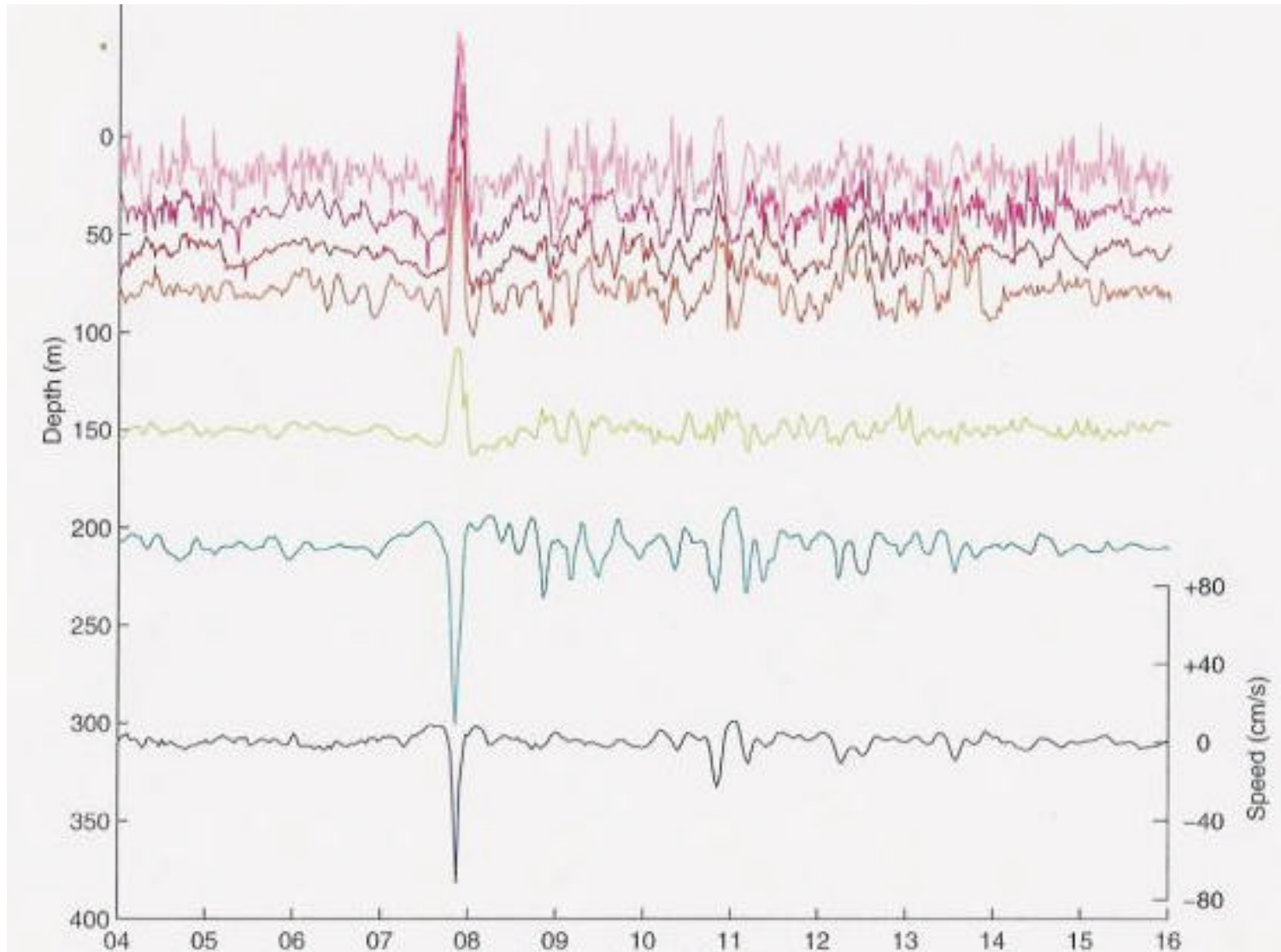
(2-Hour High-Pass Data)



GMT Hour May 9, 2001

MOORING S7 v-VELOCITY

(2-Hour High-Pass Data)



GMT Hour May 9, 2001

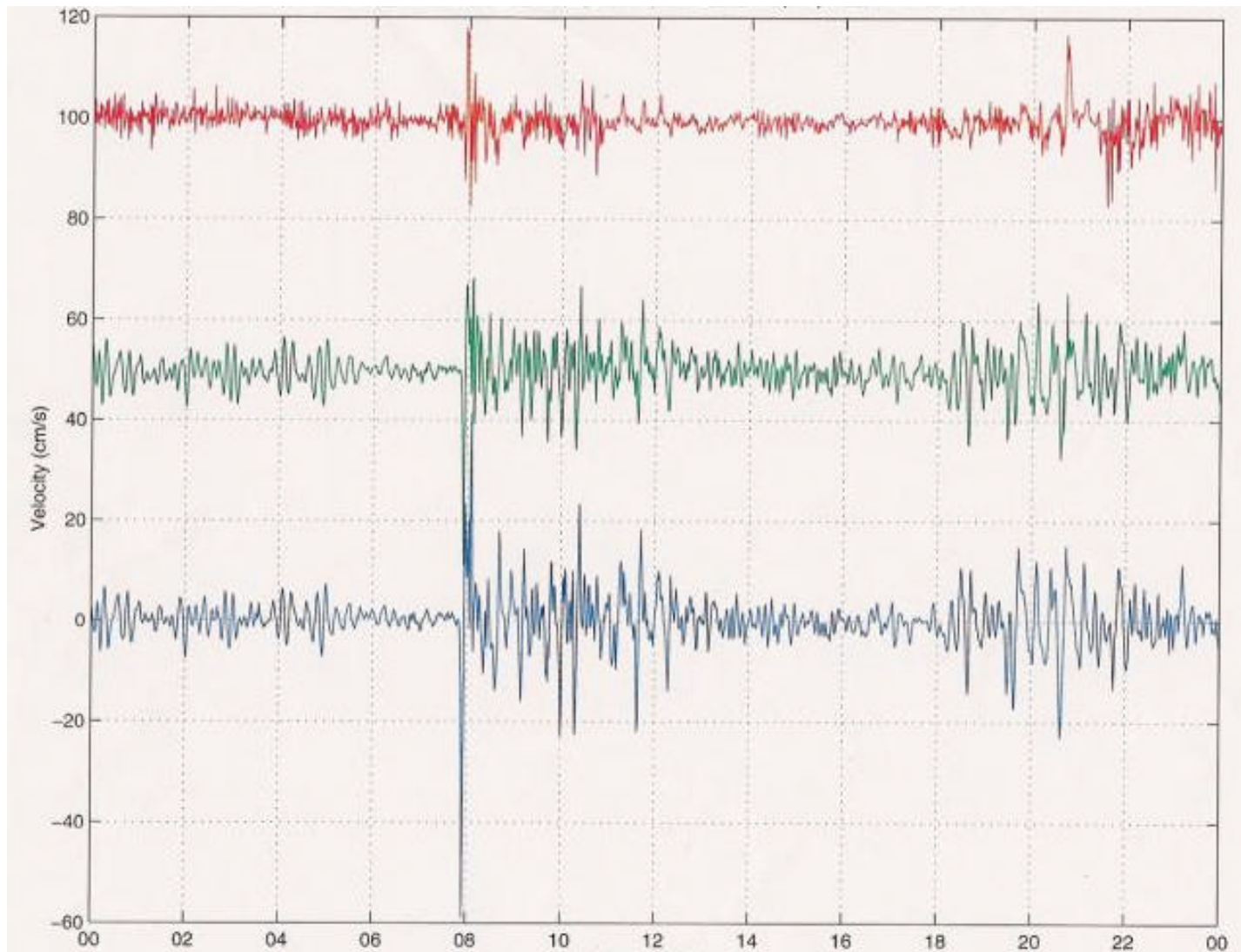
MOORING S7 w-VELOCITY

(2-Hour High-Pass Data)

10 m

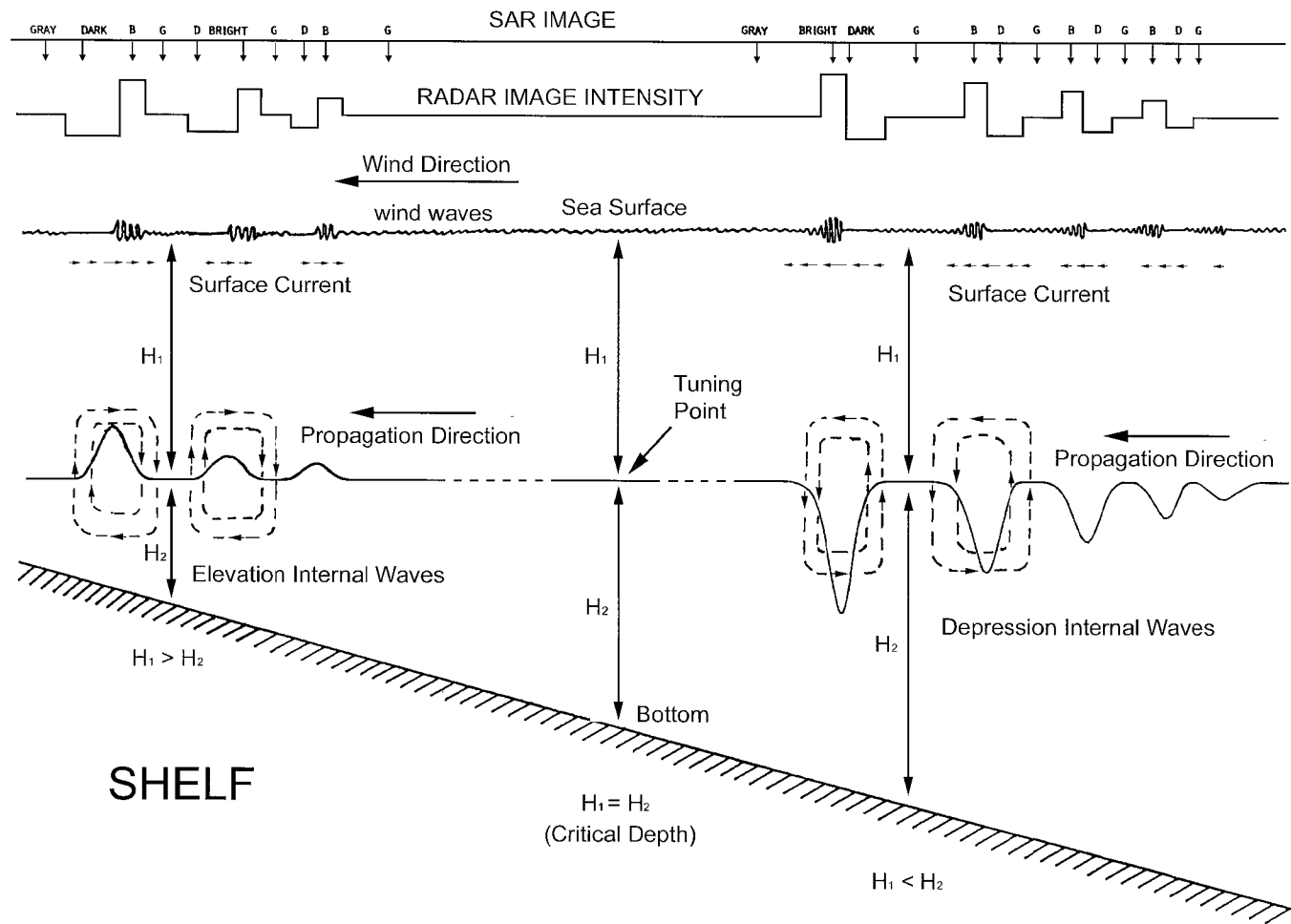
58 m

94 m



GMT Hour May 8, 2001

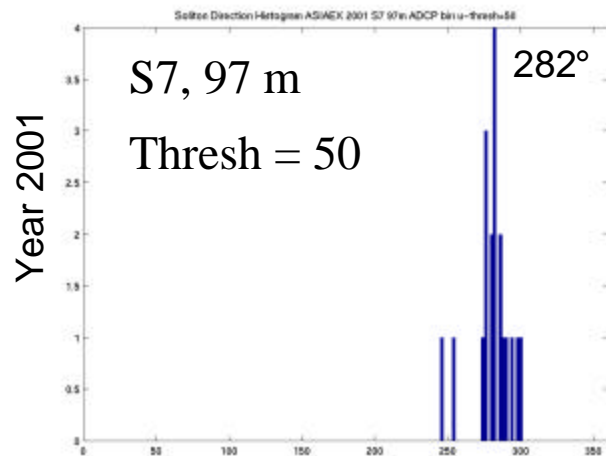
Solitons and surface roughness: How it works



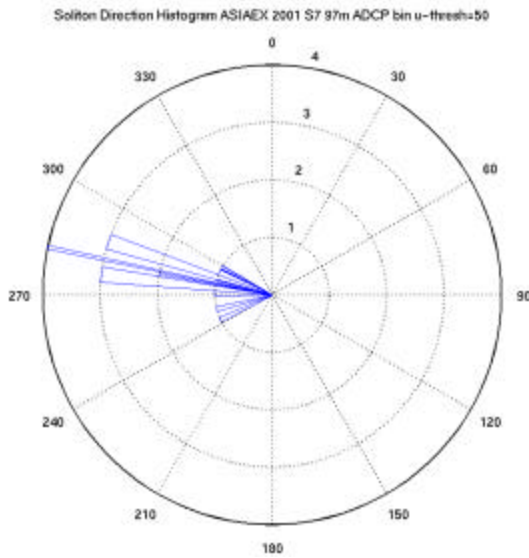
[From Hsu and Liu, 2000]

Where Are They Generated?

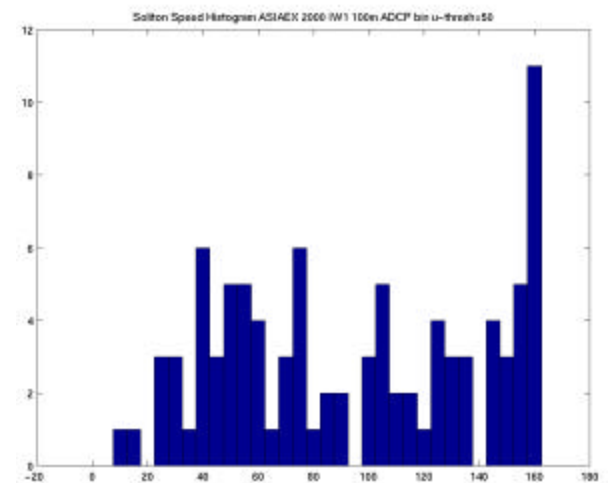
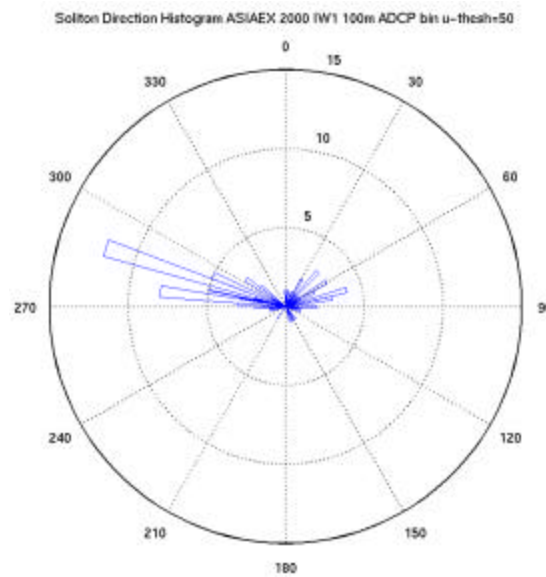
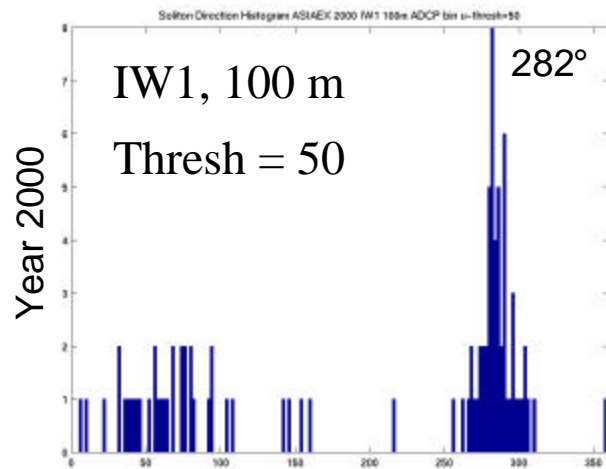
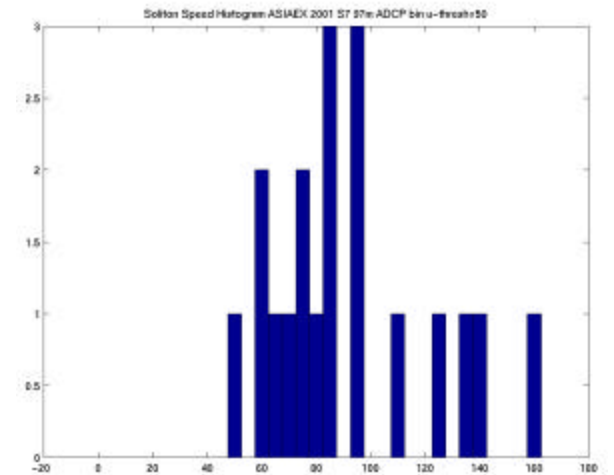
Direction



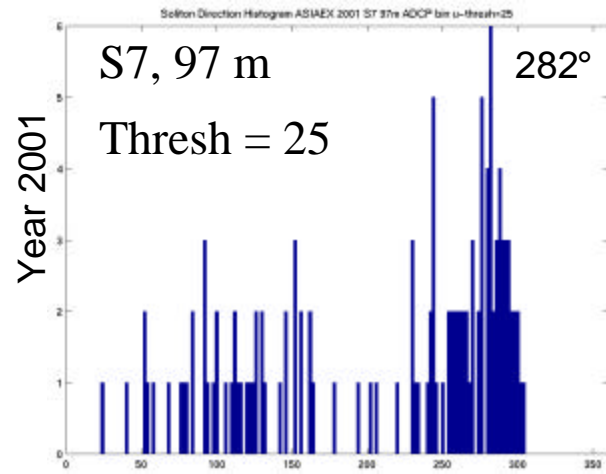
Polar Direction



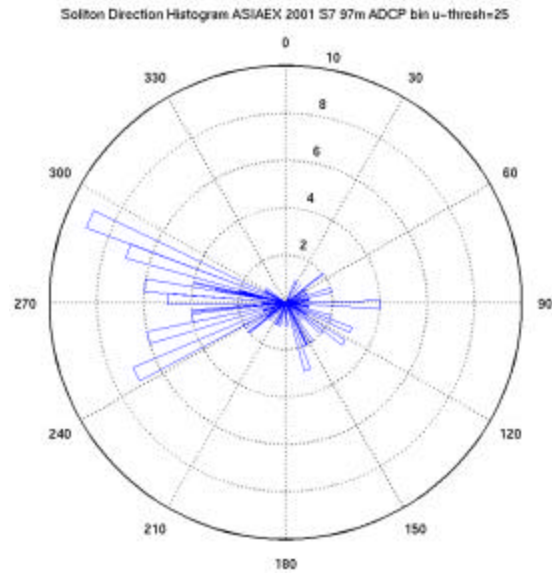
Speed



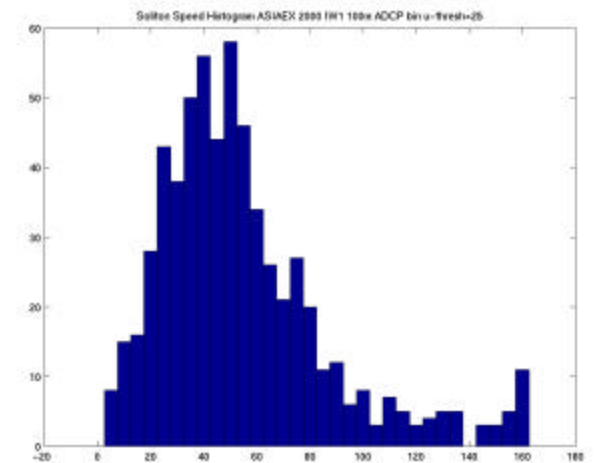
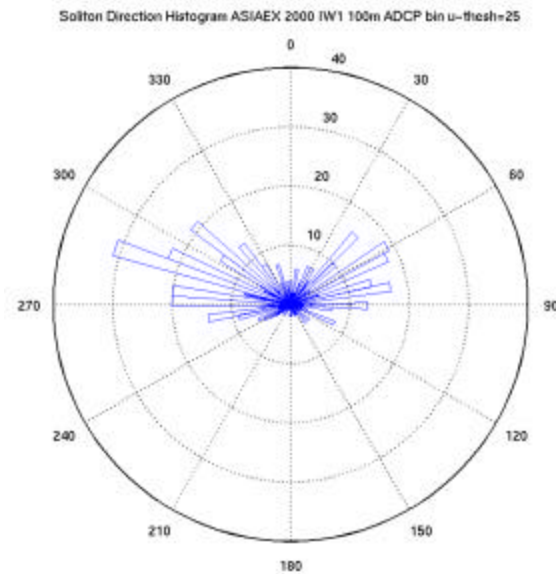
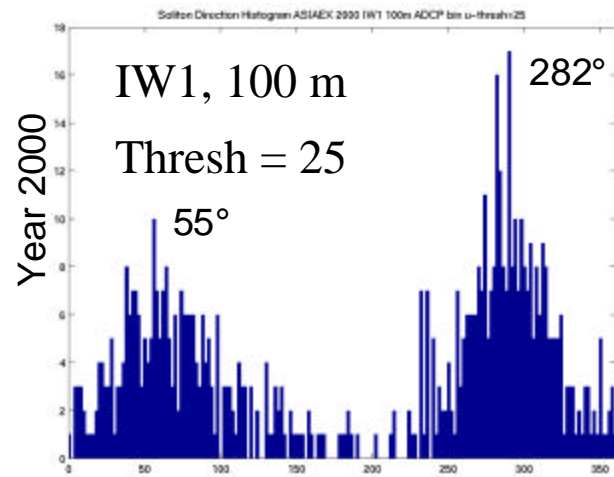
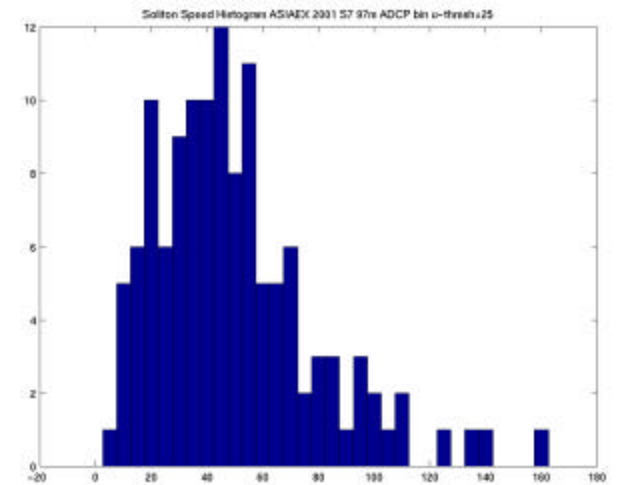
Direction

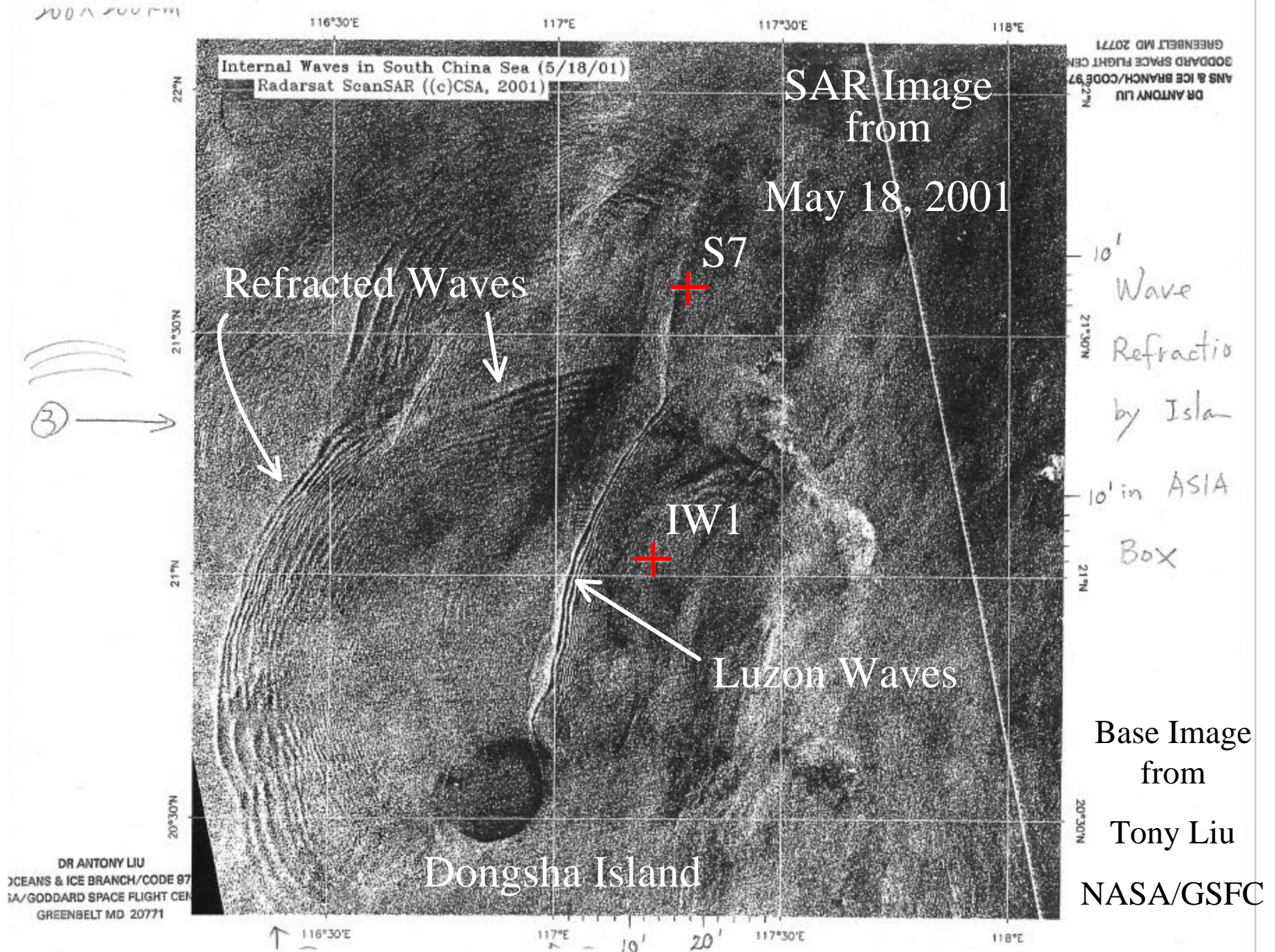


Polar Direction

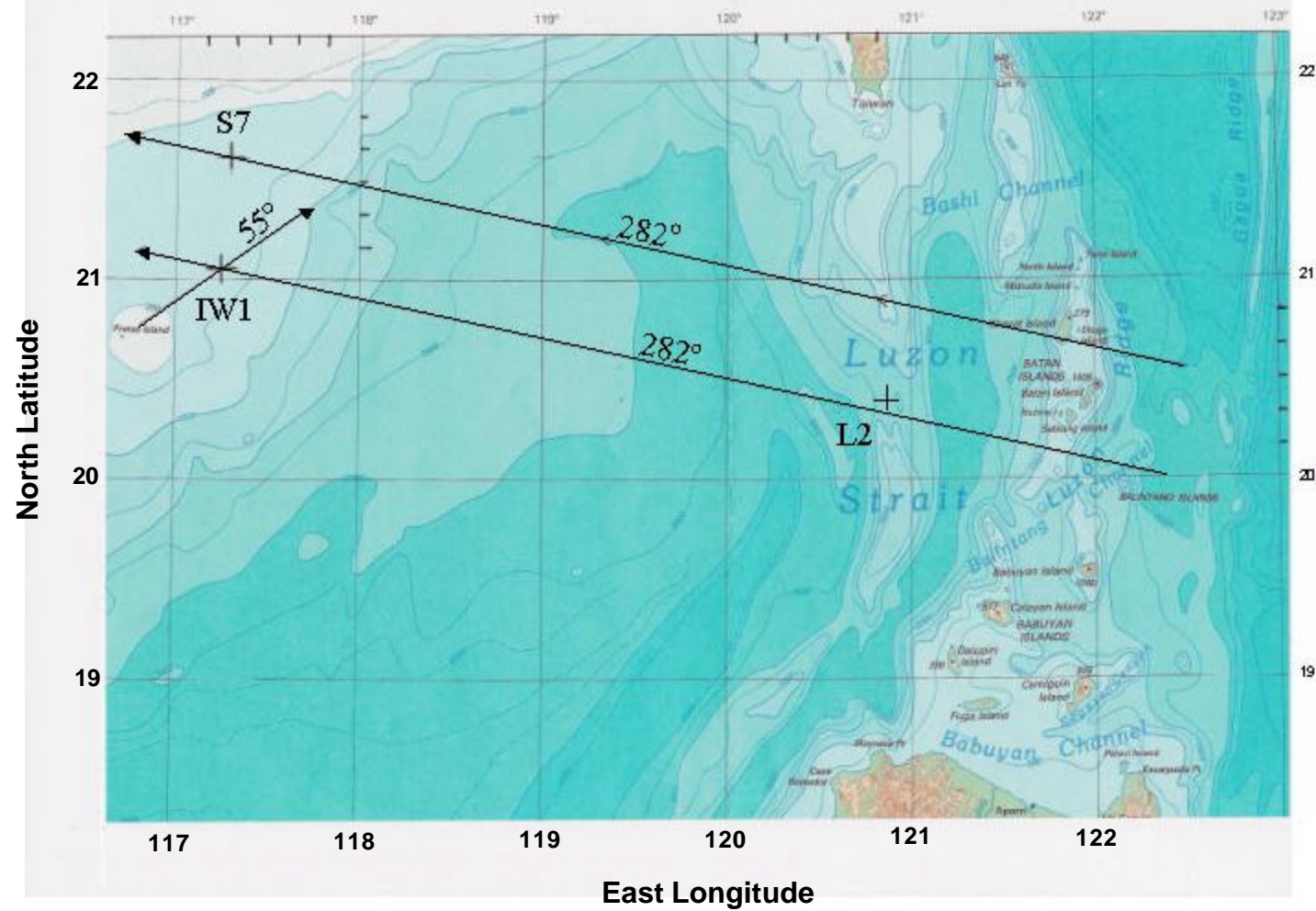


Speed





Soliton Ray Traces from ASIAEX Moorings





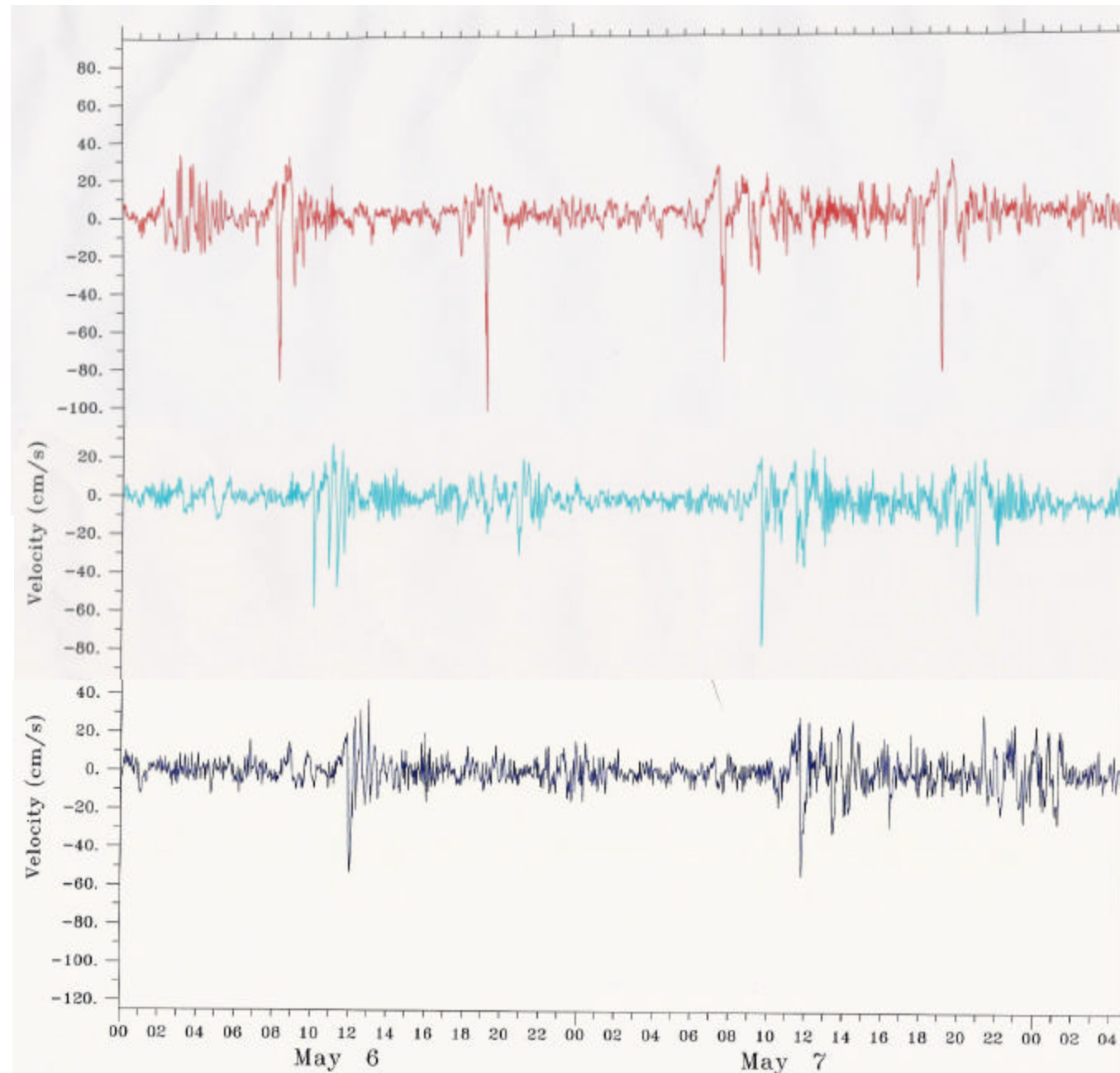
How Do They Propagate?

SOLITON PROPAGATION: U-COMPONENT AT 60 M DEPTH

S7 (350 m)

S6 (275 m)

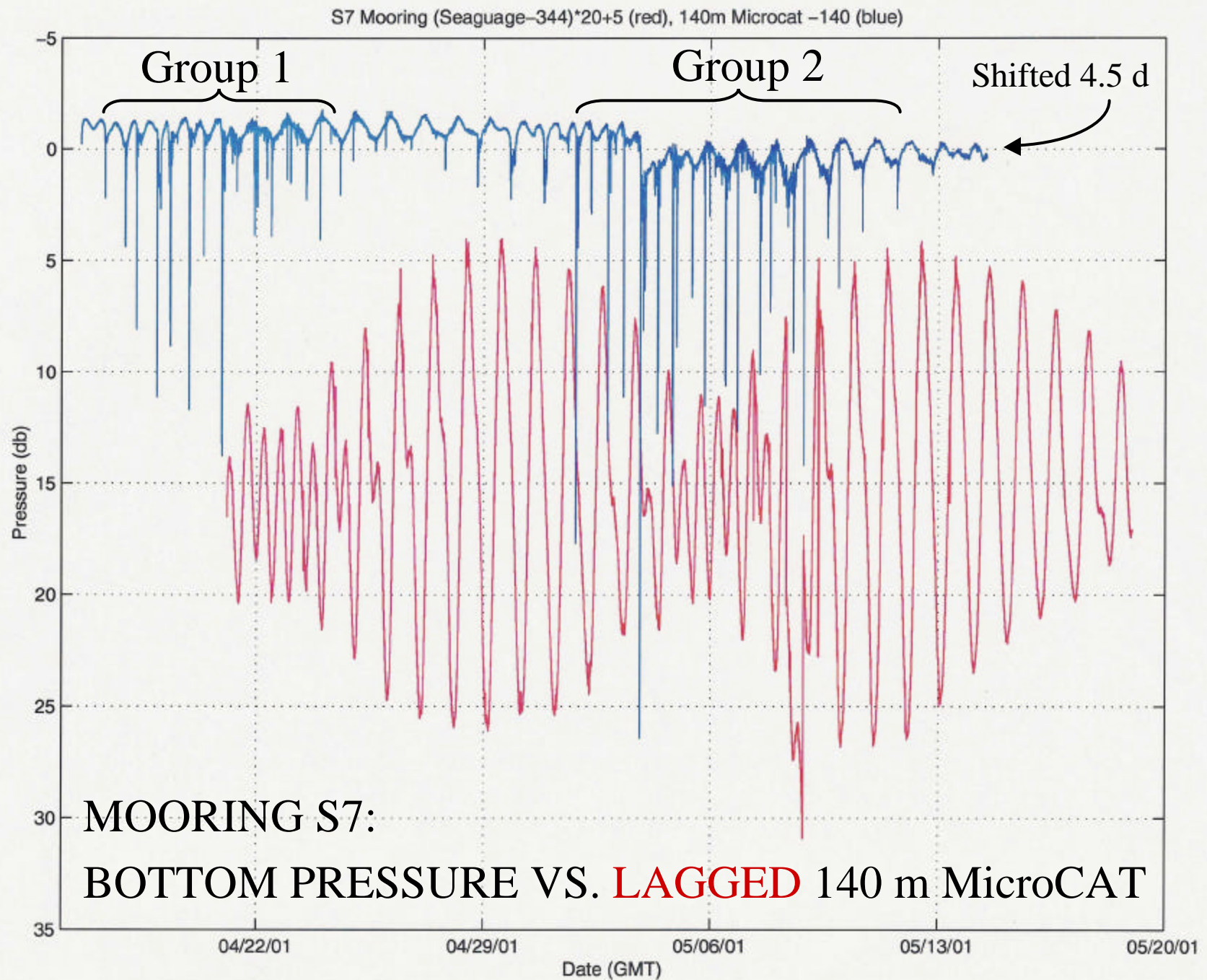
S5 (184 m)



SOLITON PHASE SPEED CALCULATIONS

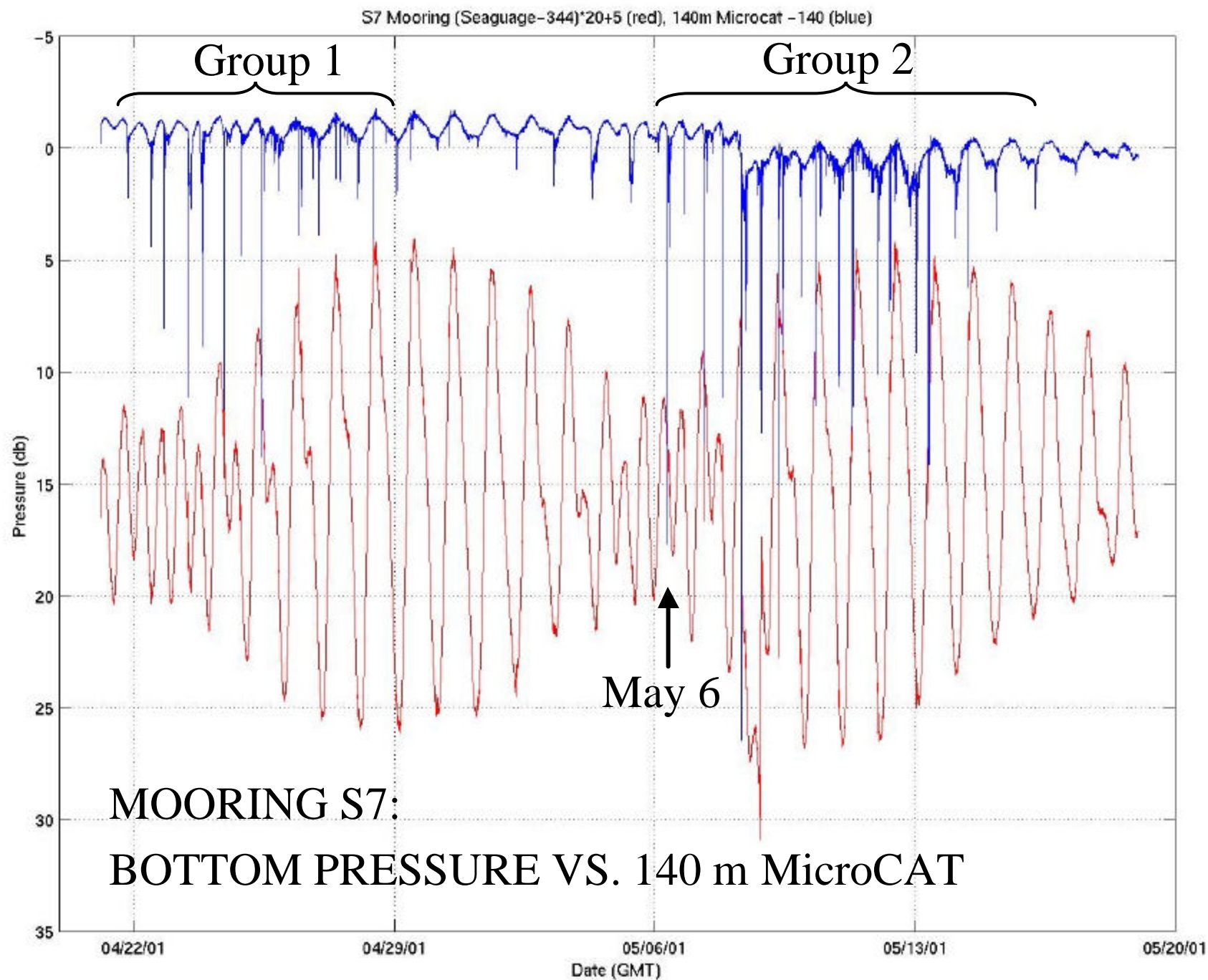
<u>Date</u>	<u>S7 time</u>	<u>S5 time</u>	<u>dt(hrs)</u>	<u>x(km)</u>	<u>speed(m/s)</u>
May 6 2001	126.34351	126.49999	3.7555	16.6	1.22
May 6 2001	126.80453	126.95345	3.5741	16.6	1.29
May 7 2001	127.32942	127.49513	3.9770	16.6	1.16
May 7 2001	127.81335	127.96595	3.6624	16.6	1.26
May 8 2001	128.33130	128.51666	4.4486	16.6	1.03
May 9 2001	129.32694	129.51666	4.5533	16.6	1.01
May 9 2001	129.45191	129.63332	4.3538	16.6	1.06
May 9 2001	129.92265	130.09234	4.0726	16.6	1.13
May 12 2001	132.00210	132.13331	3.1490	16.6	1.46
May 12 2001	132.33189	132.46874	3.2844	16.6	1.40
May 13 2001	133.36571	133.48888	2.9561	16.6	1.56
May 14 2001	134.43980	134.57152	3.1613	16.6	1.46

So, at 4.5 days to propagate from the Luzon Strait to the ASIAX Site, the true phase relation of the “groups” with the tide looks like this!



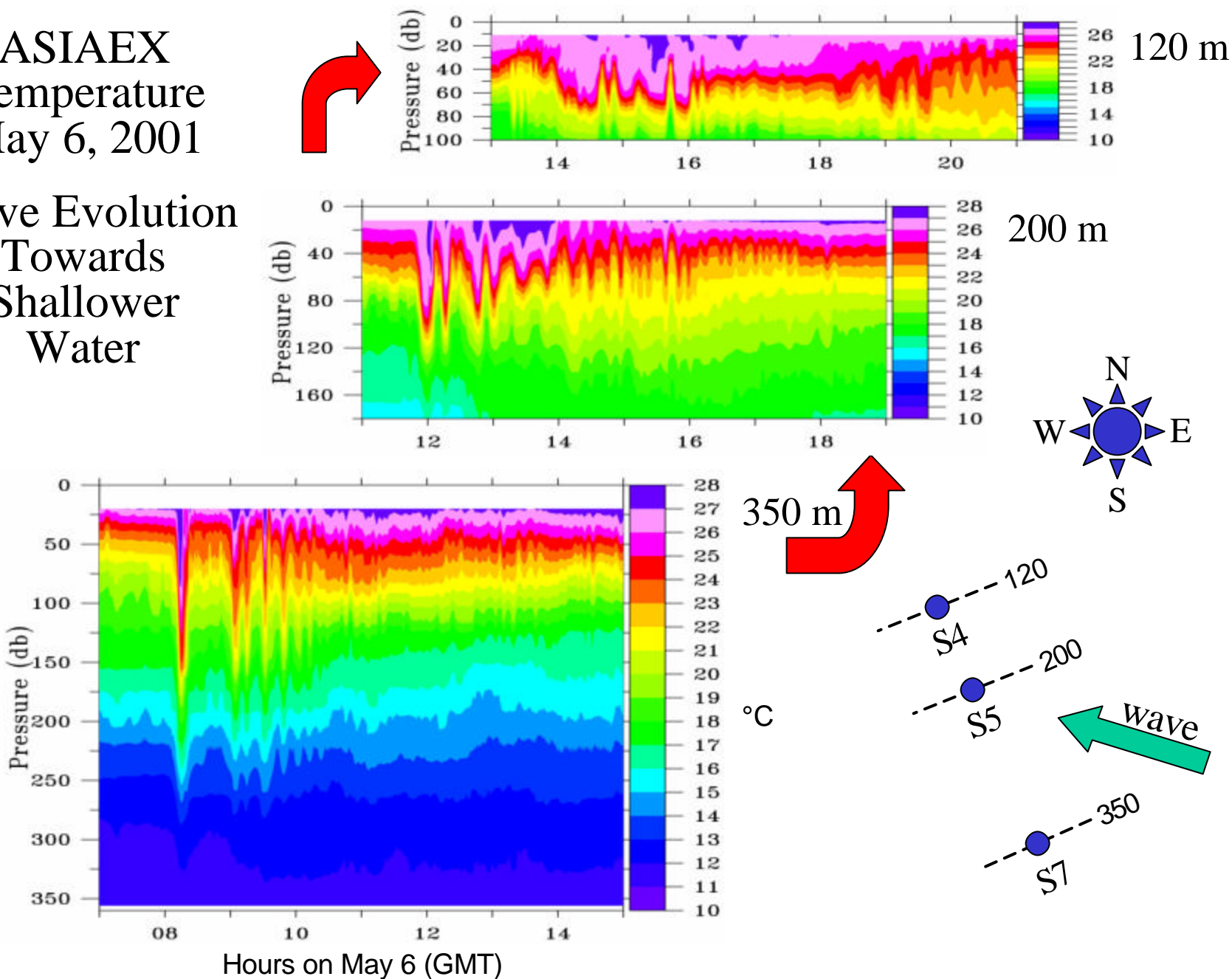
What Happens When They Hit The Continental Shelf?

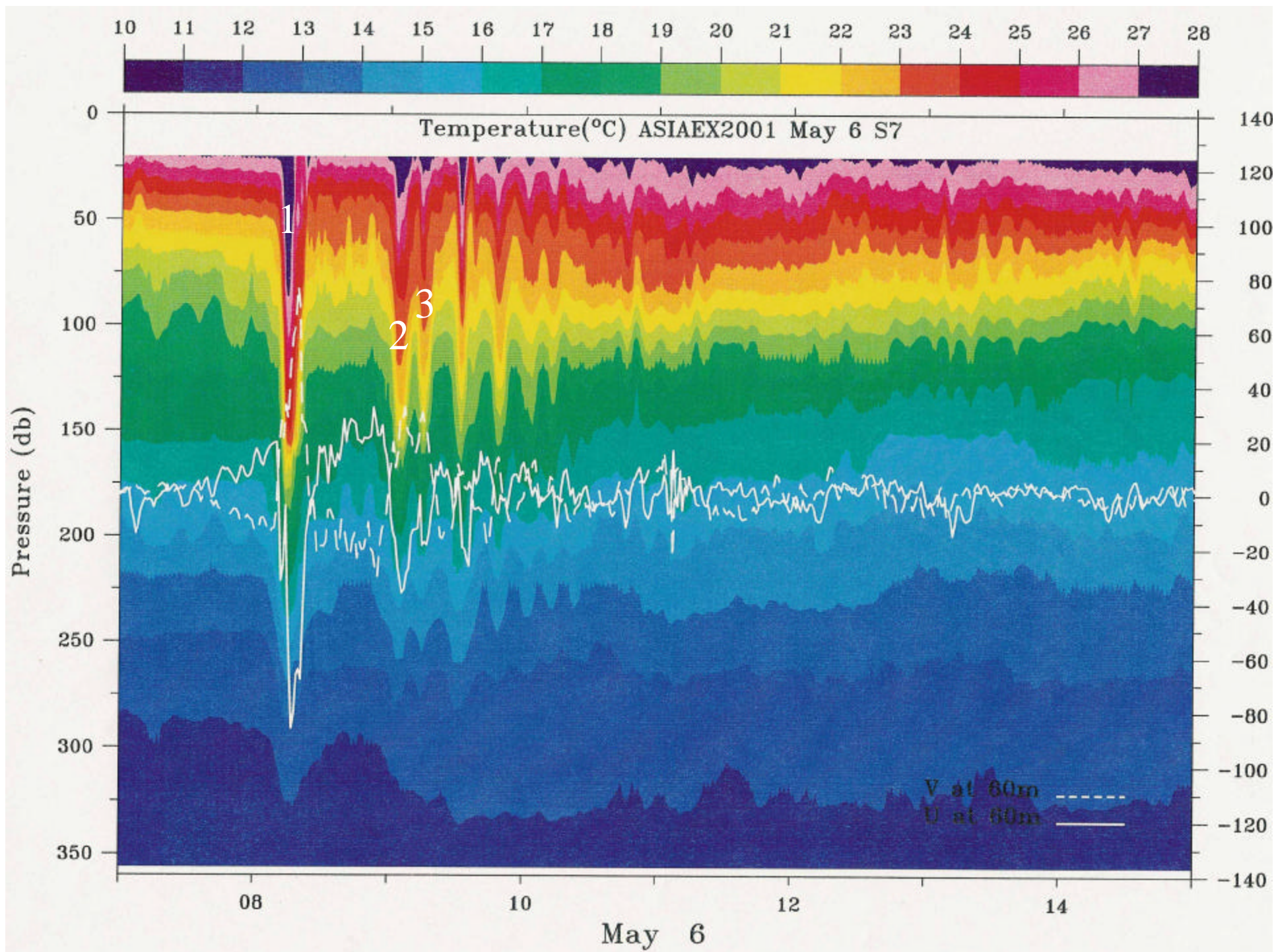
[With Application to Elevation Waves]

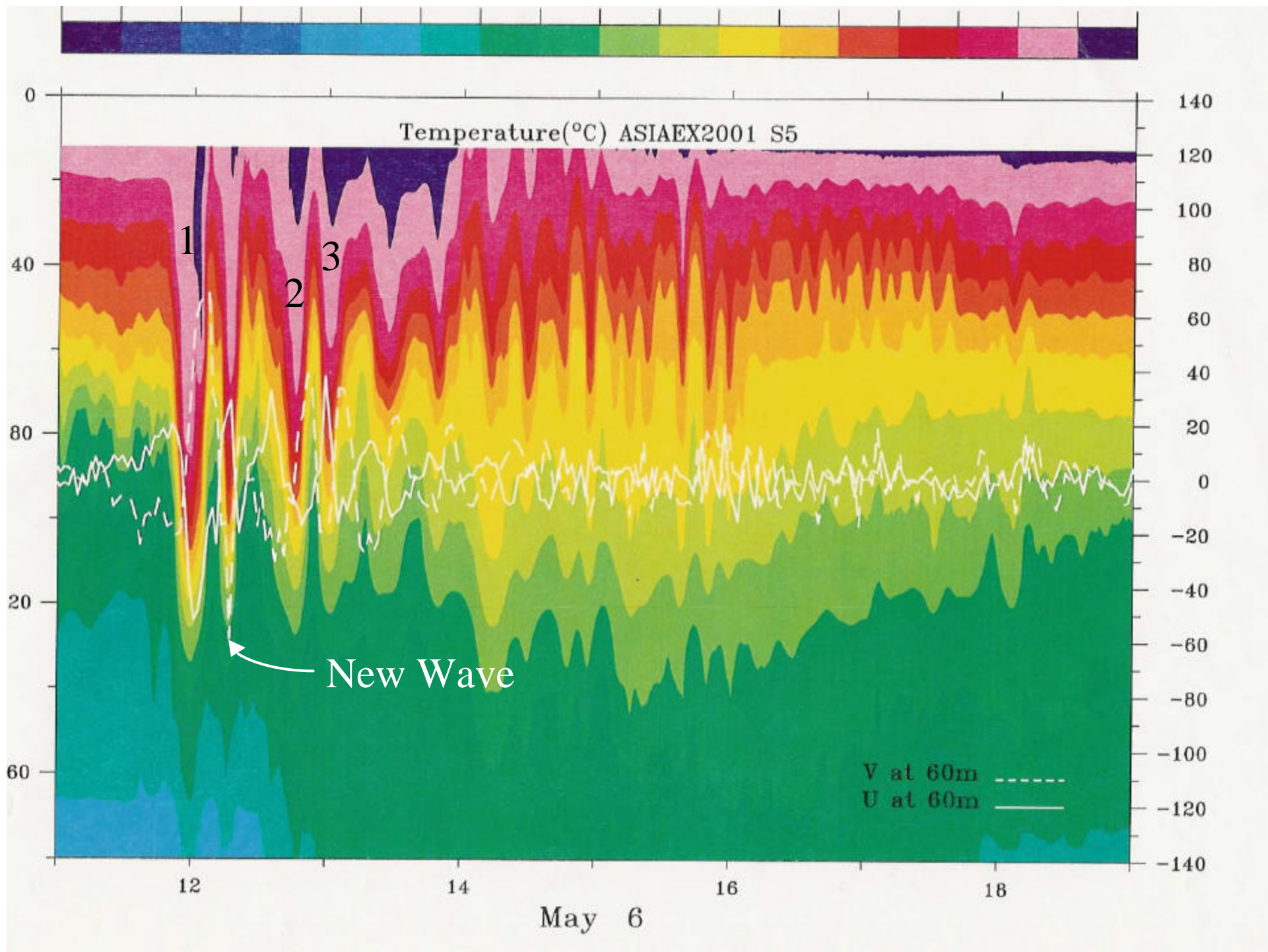


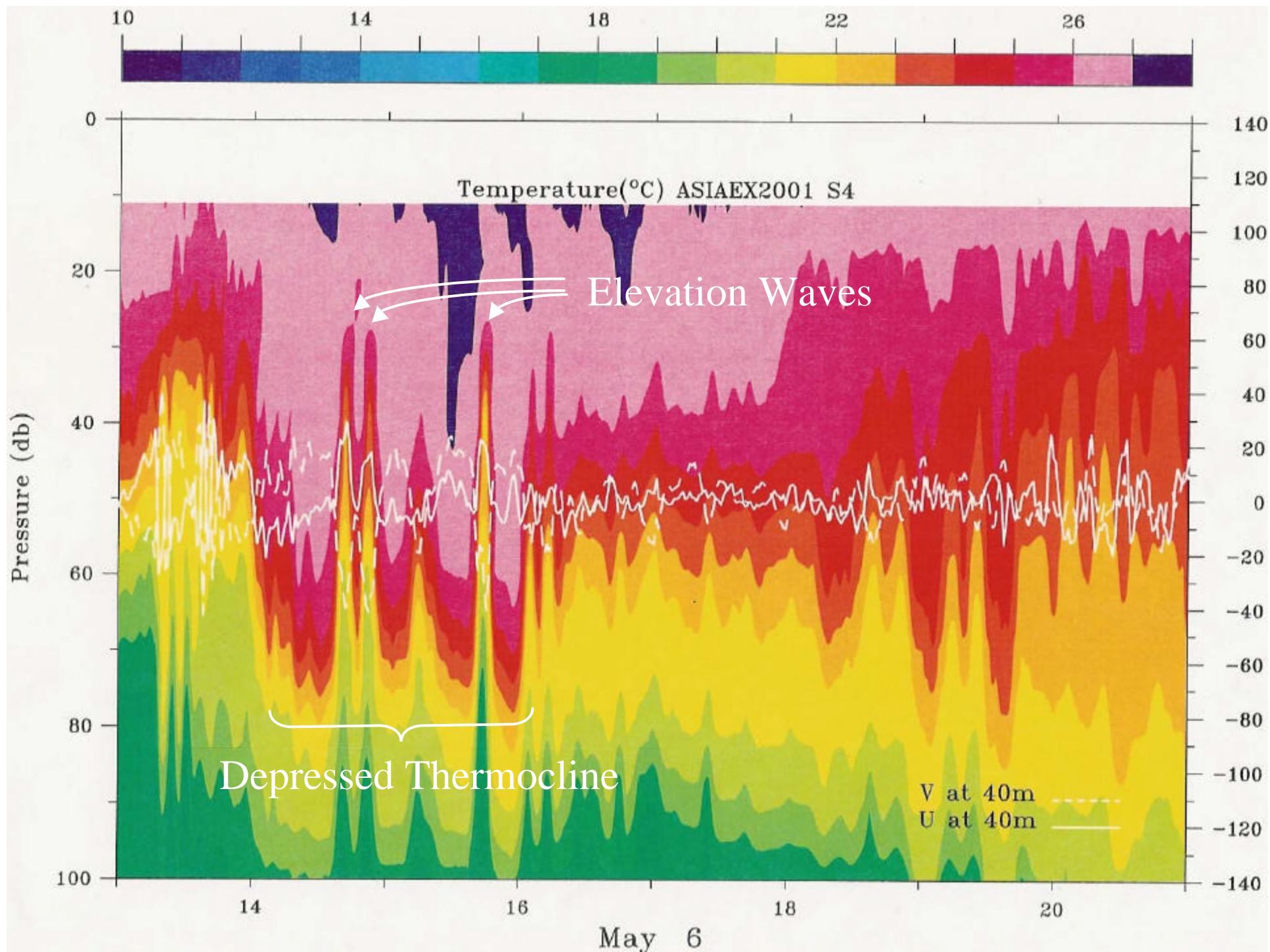
ASIAEX
Temperature
May 6, 2001

Wave Evolution
Towards
Shallower
Water



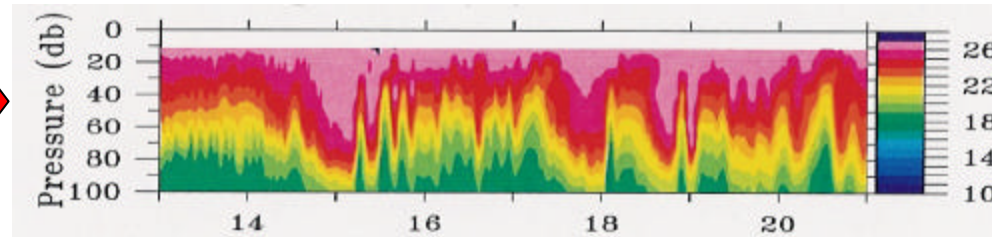




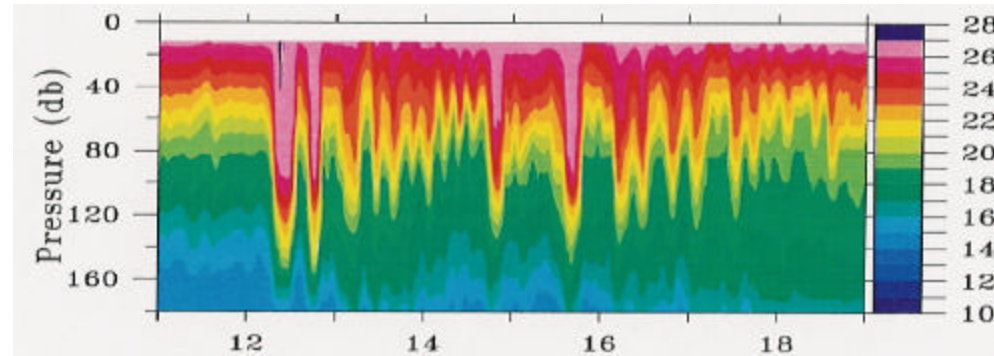


ASIAEX Temperature May 8, 2001

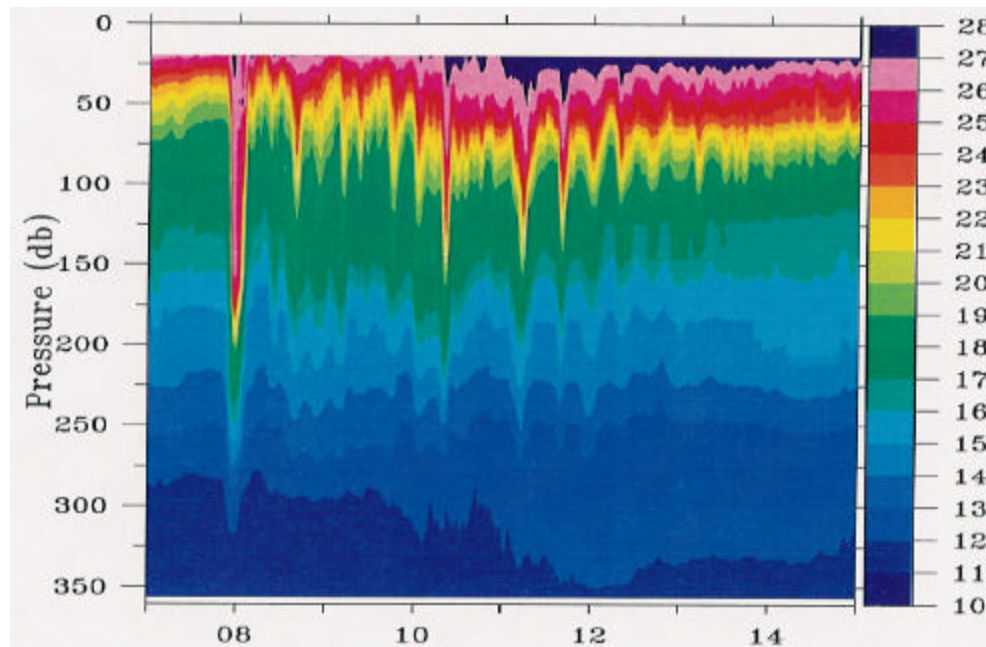
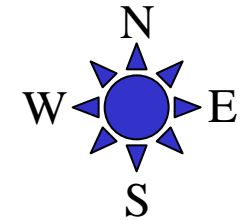
Wave Evolution Towards Shallower Water



120 m

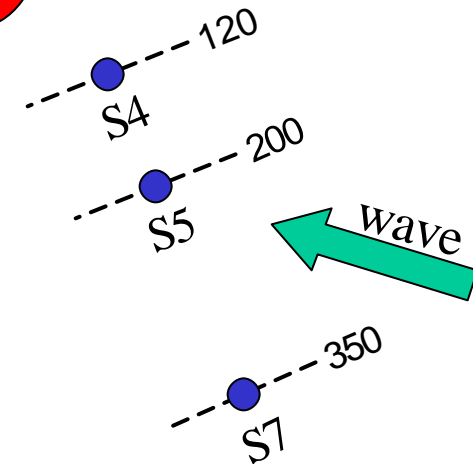
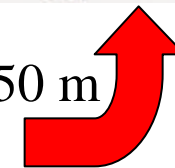


200 m



350 m

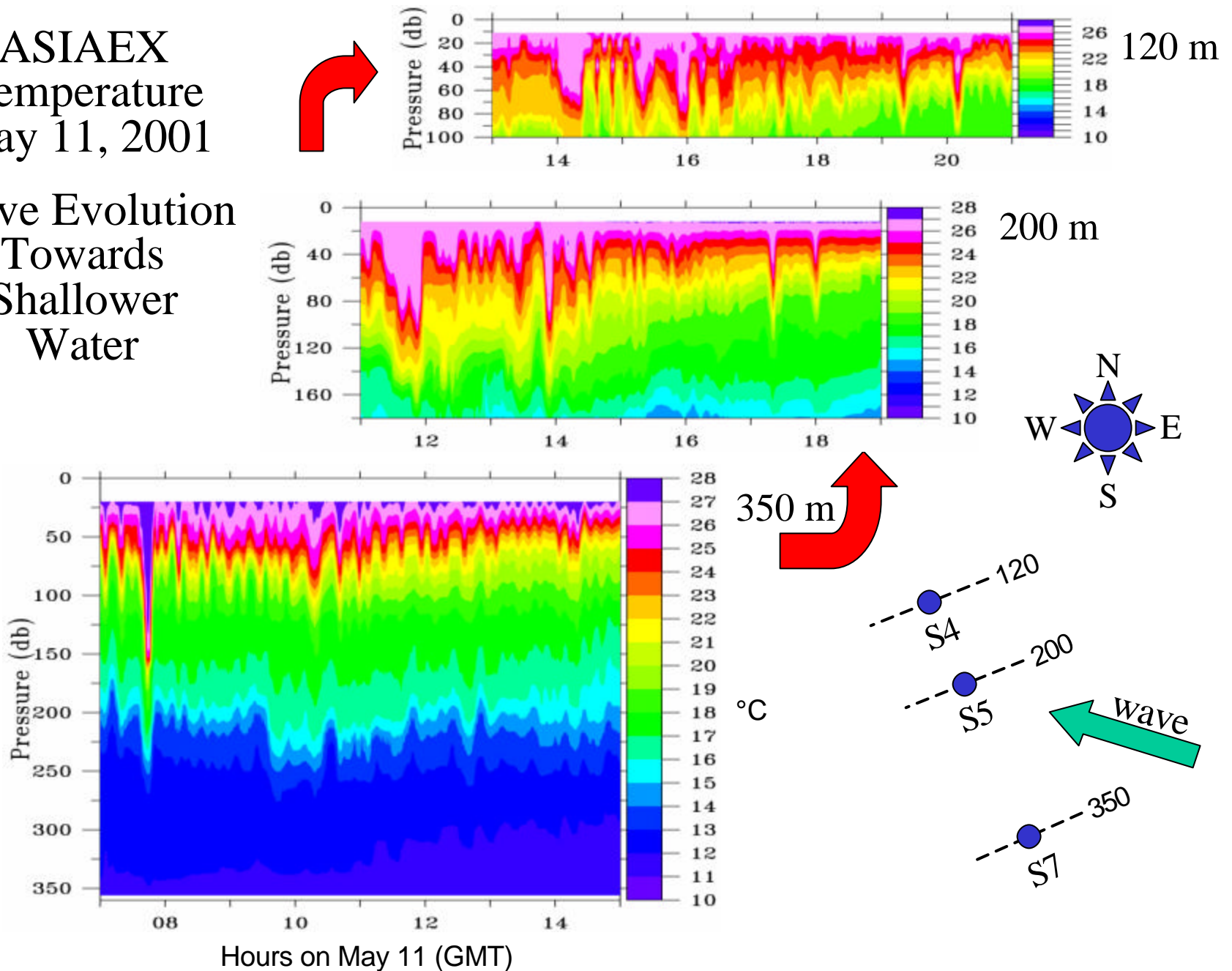
°C



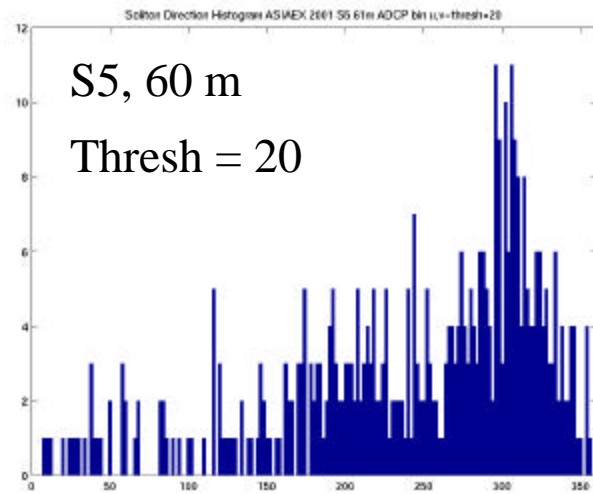
Hours on May 8 (GMT)

ASIAEX
Temperature
May 11, 2001

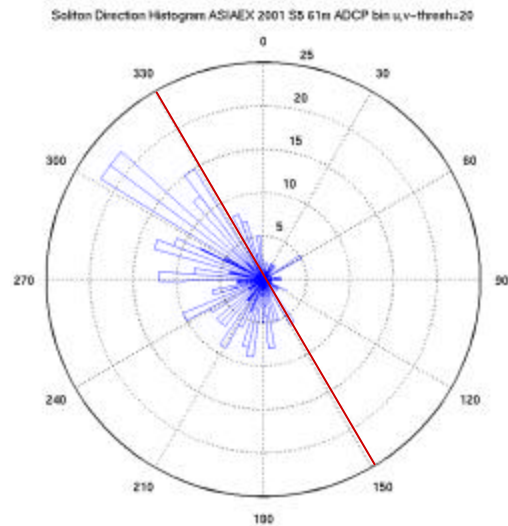
Wave Evolution
Towards
Shallower
Water



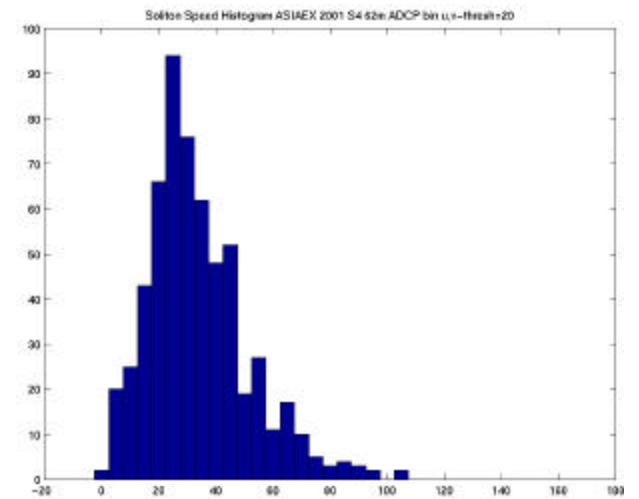
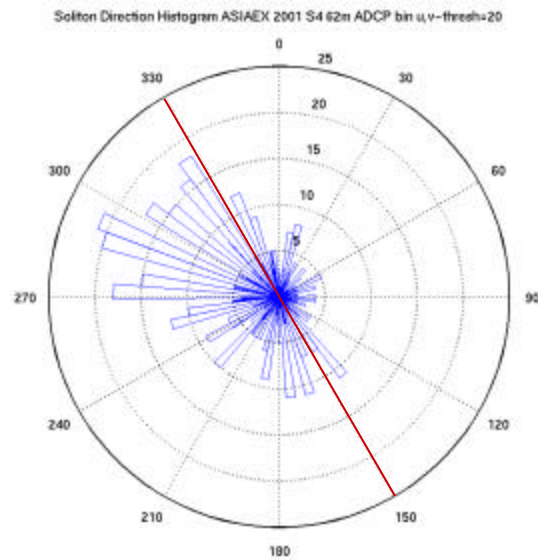
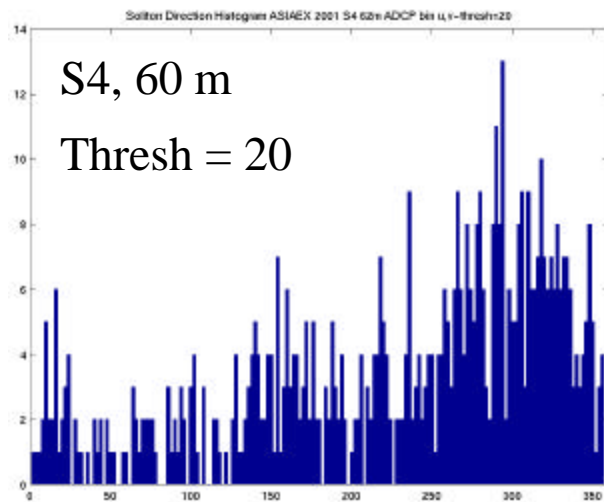
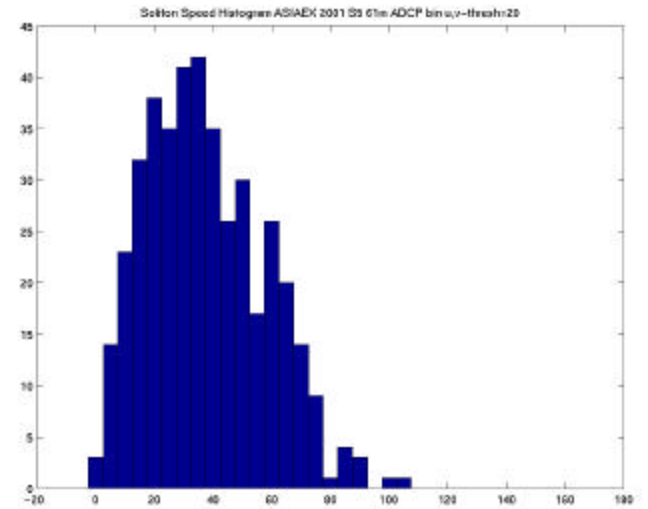
Direction



Polar Direction



Speed



SUMMARY

- **At least three soliton generation regions for the continental shelf in the northeastern SCS**
 - Luzon Strait
 - Dongsha Island (Pratis Reef)
 - Local Continental Shelf Break
- **Luzon Strait waves**
 - Generated on neap tide when semidiurnal
 - Travel WNW towards 282° at about $1\text{--}1.4\text{ m s}^{-1}$
- **Mode-1 Waves Dominant**
- **Wave field on shelf very complicated, multiple sources interacting**

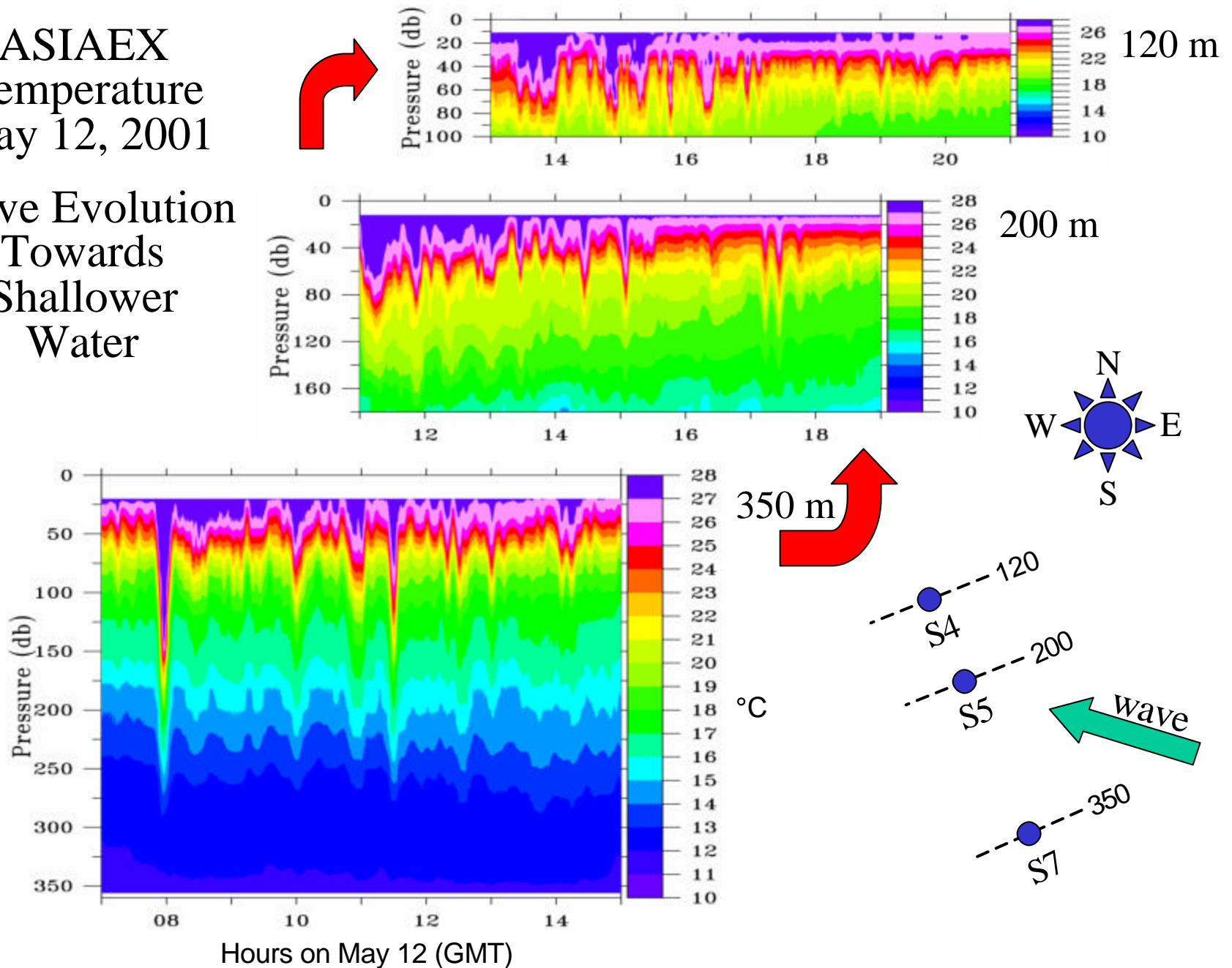
Future Work

- Need Full-Year Time Series for Predictability
 - Waves generated year-round?
- Need Concurrent Observations at Generation Site
 - Relationship between generation and barotropic tide
- Need Mid-Basin Observations
 - Spatial variation in propagation speed and vertical structure

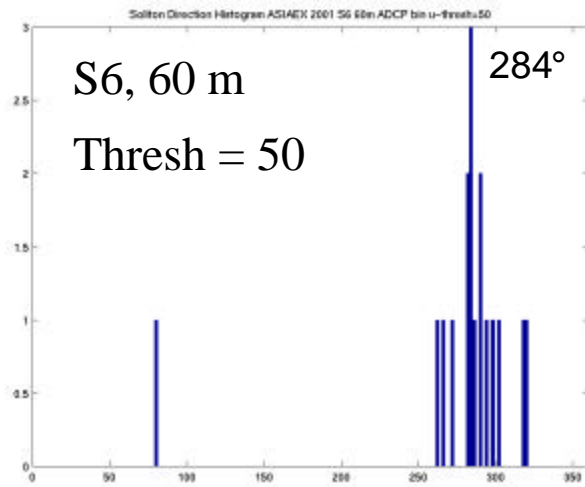
Extra Slides for Questions

ASIAEX
Temperature
May 12, 2001

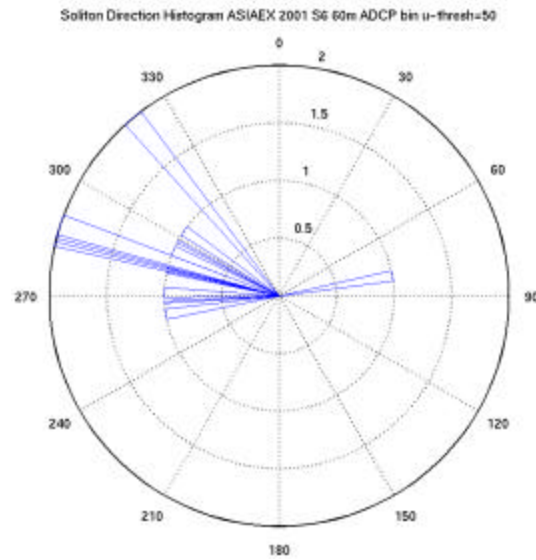
Wave Evolution
Towards
Shallower
Water



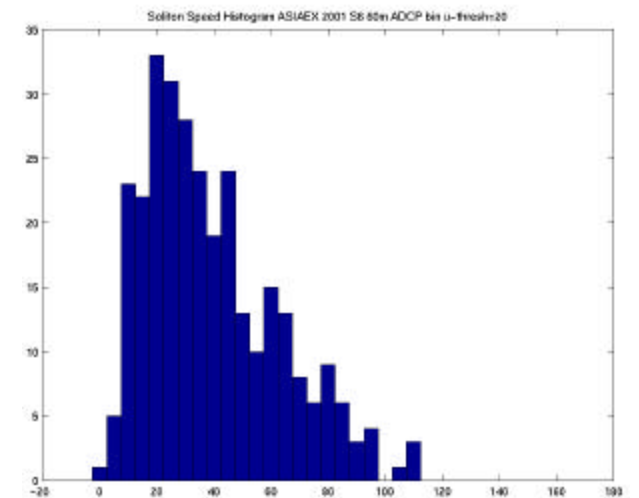
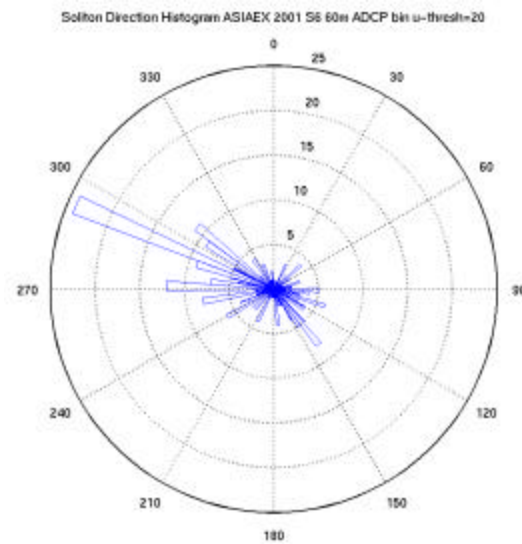
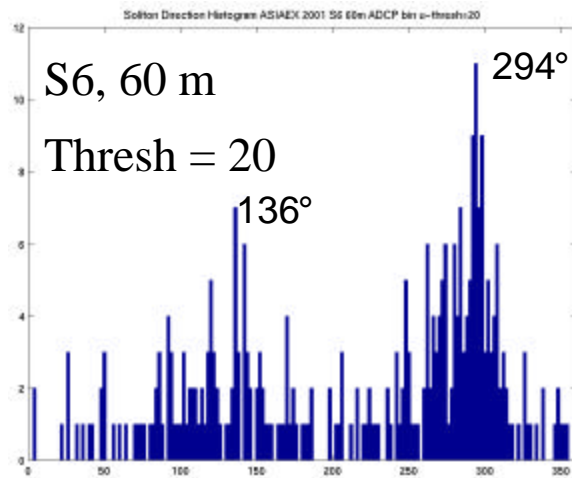
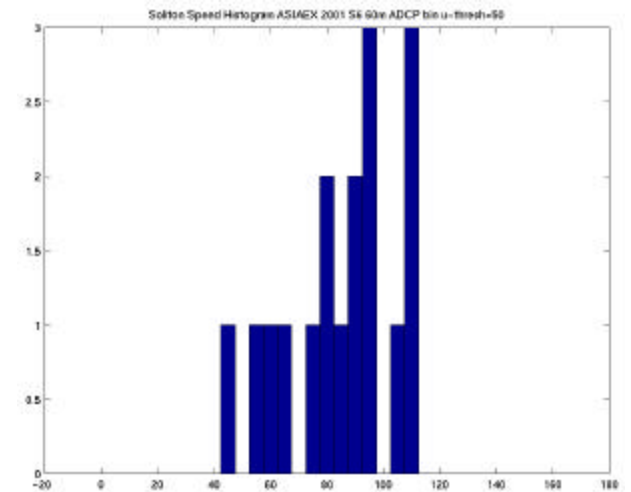
Direction



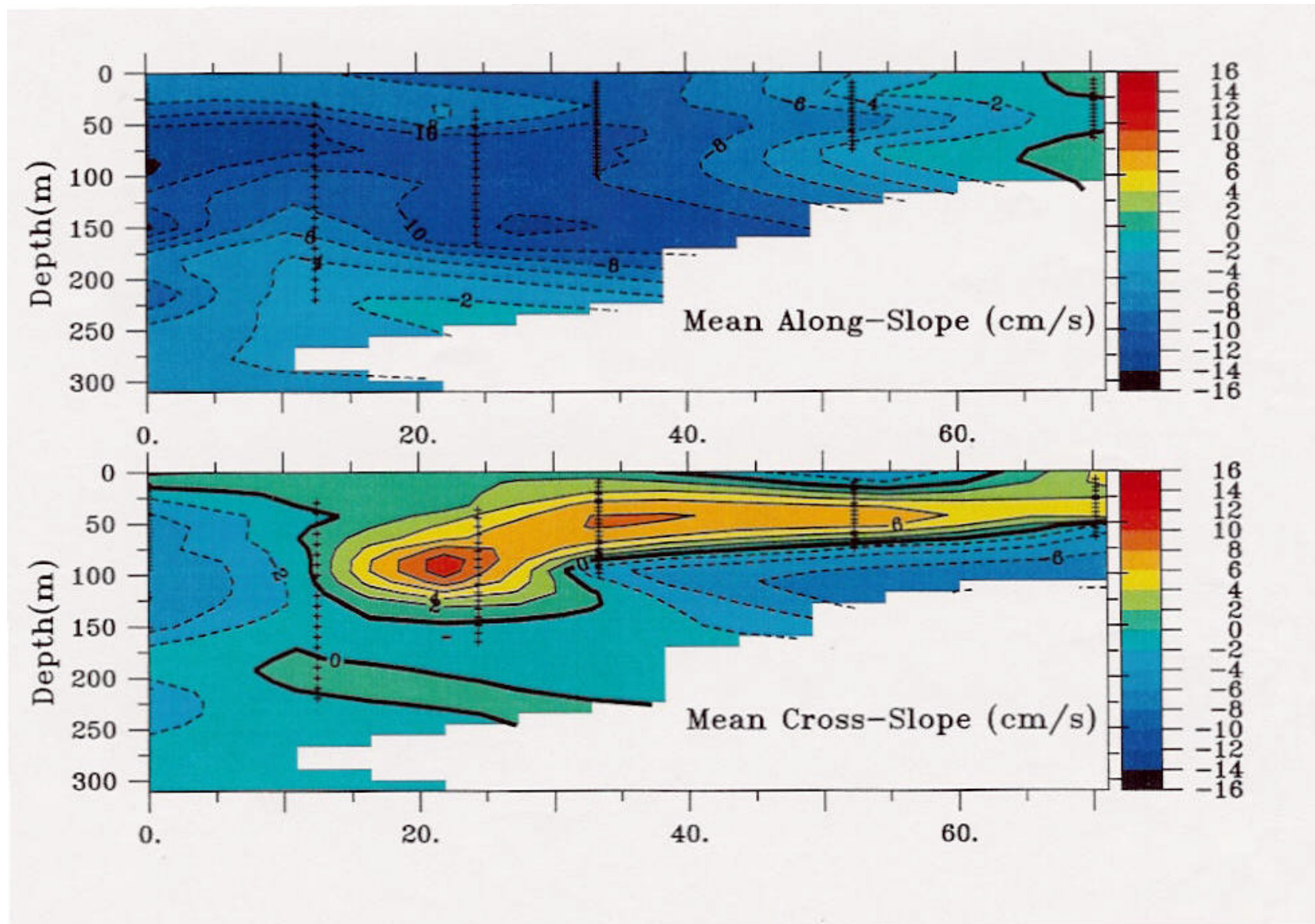
Polar Direction



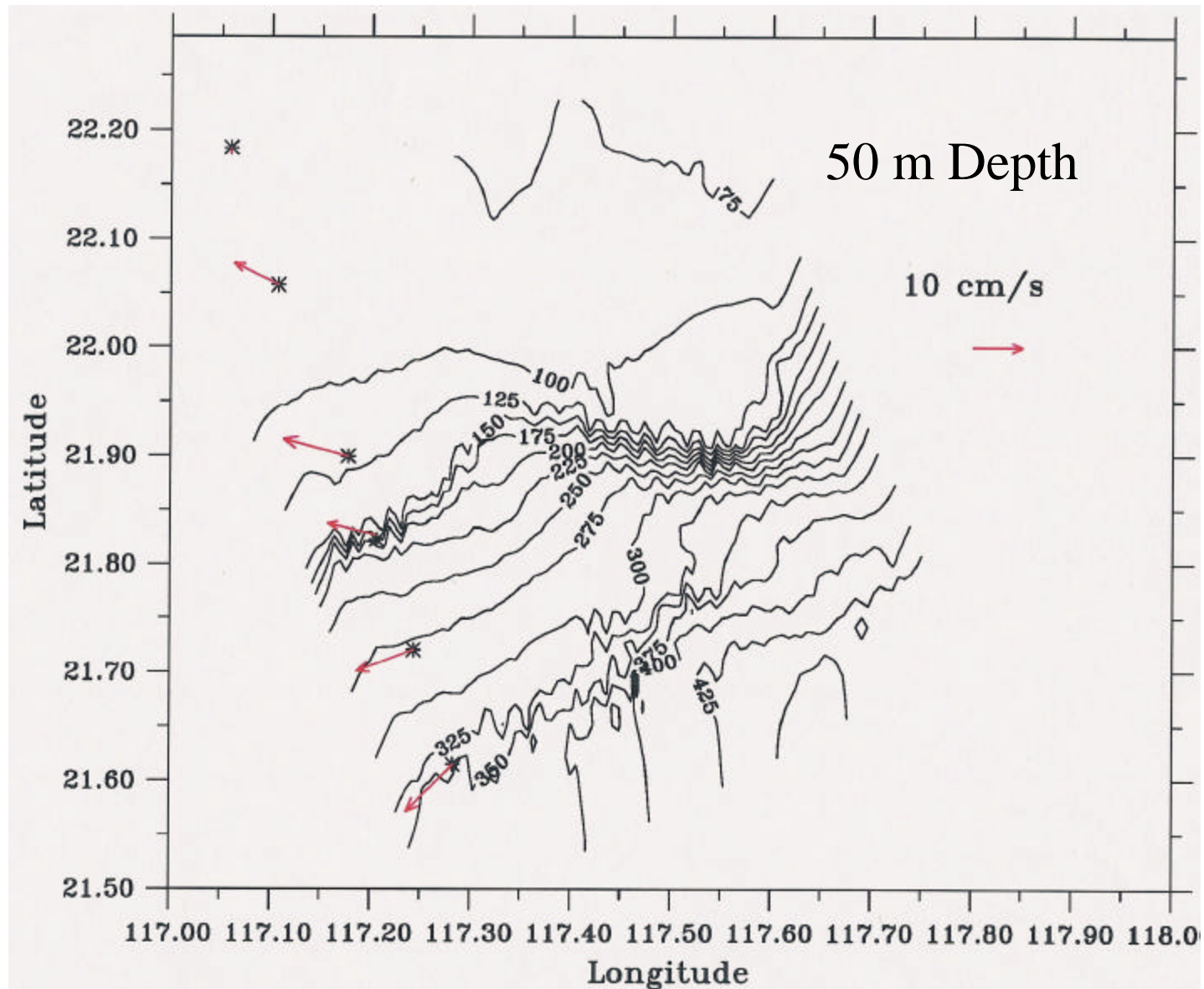
Speed



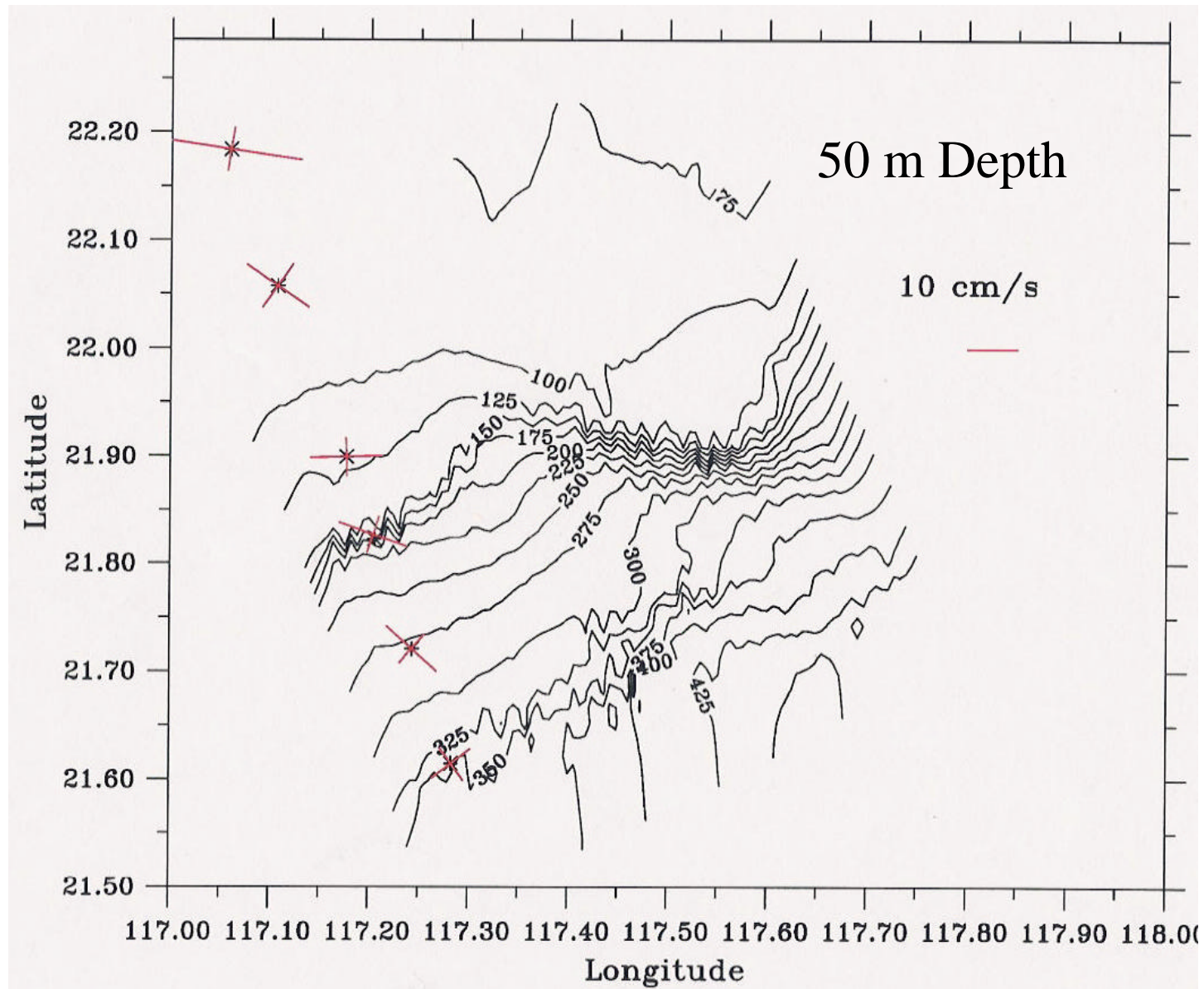
ASIAEX SCS MOORED ARRAY: MEAN VELOCITY COMPONENTS FROM ALL MOORINGS



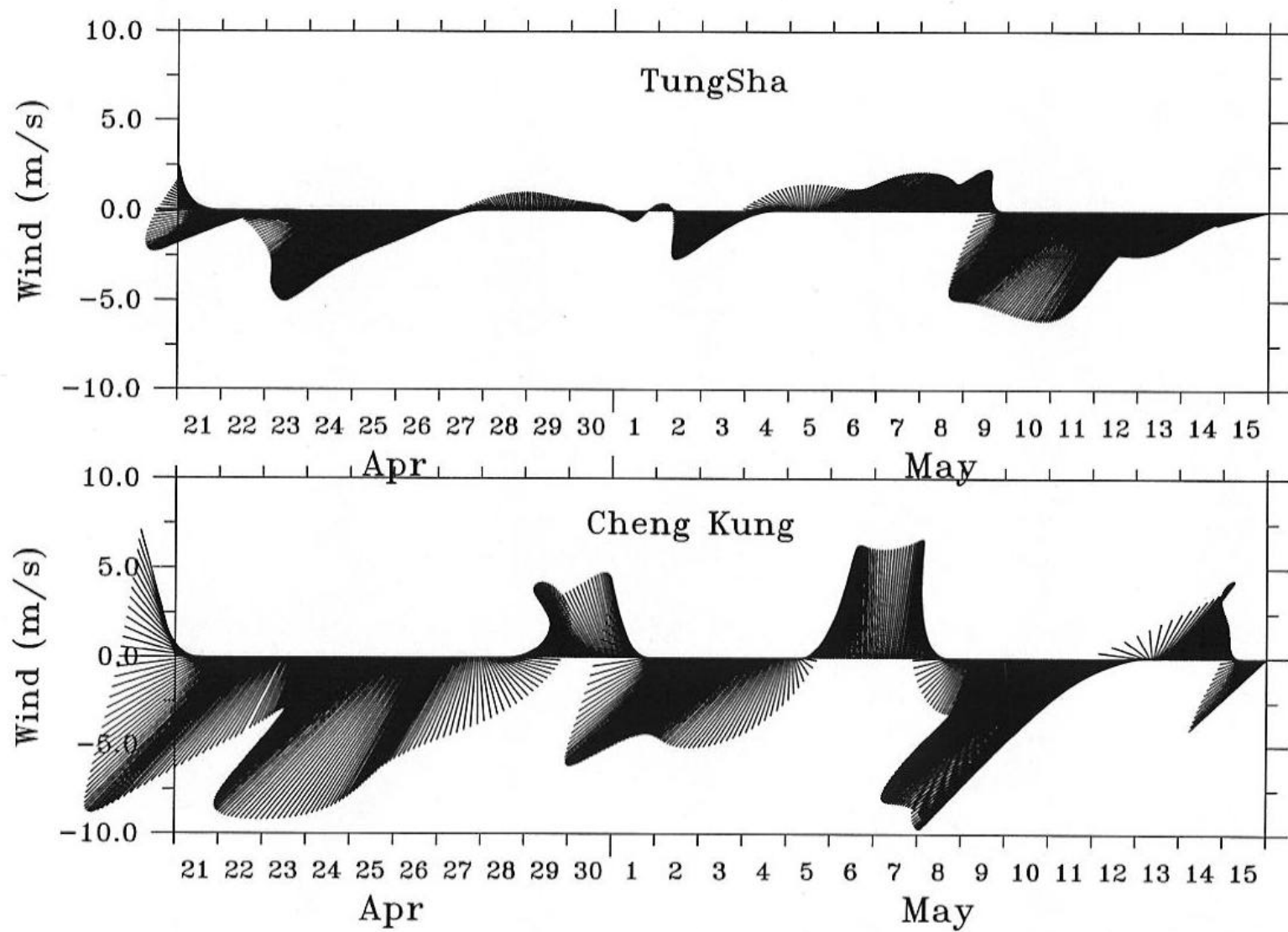
ASIAEX MOORINGS: MEAN CURRENT VECTORS



ASIAEX MOORINGS: VARIANCE ALONG PRINCIPAL AXES



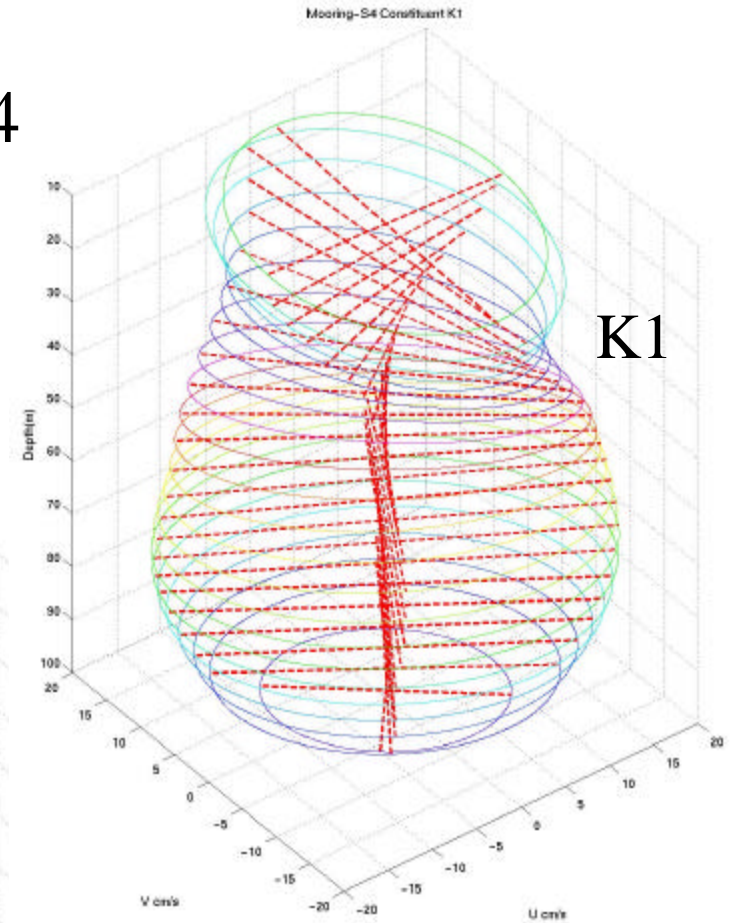
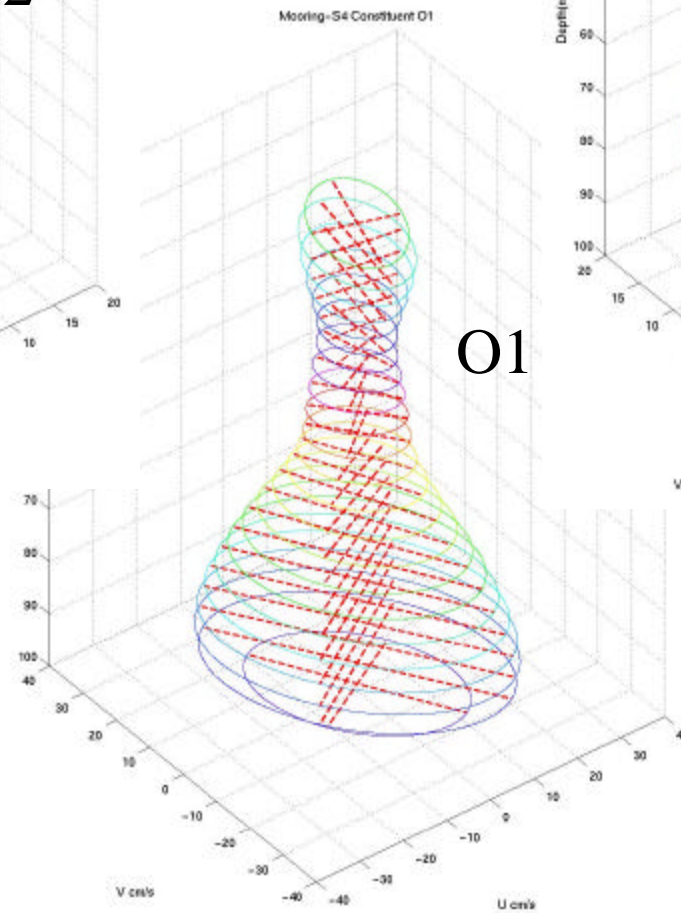
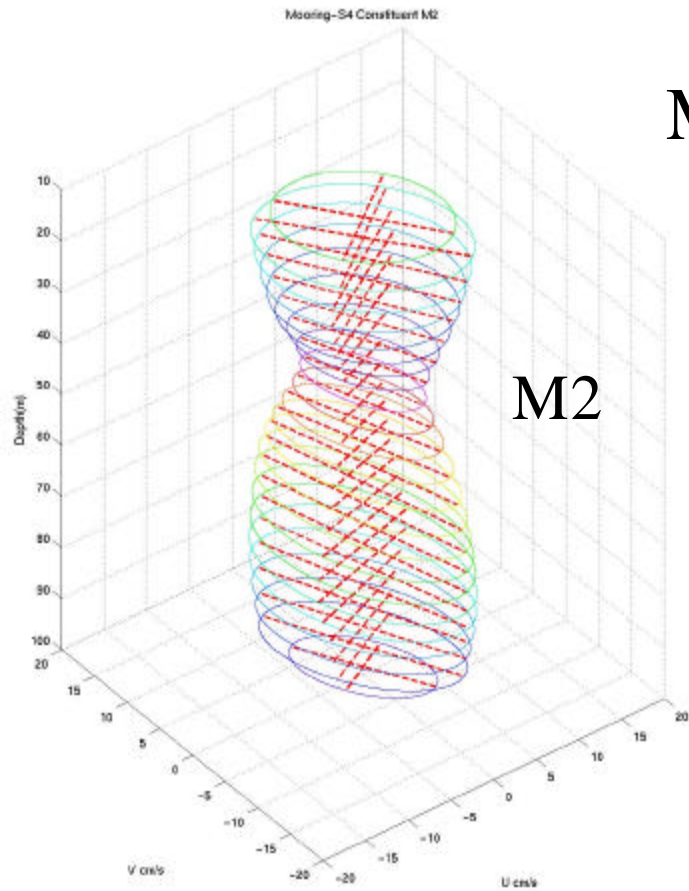
WIND VECTORS FROM TUNGSHA AND OCEAN BUOY



ASIAEX

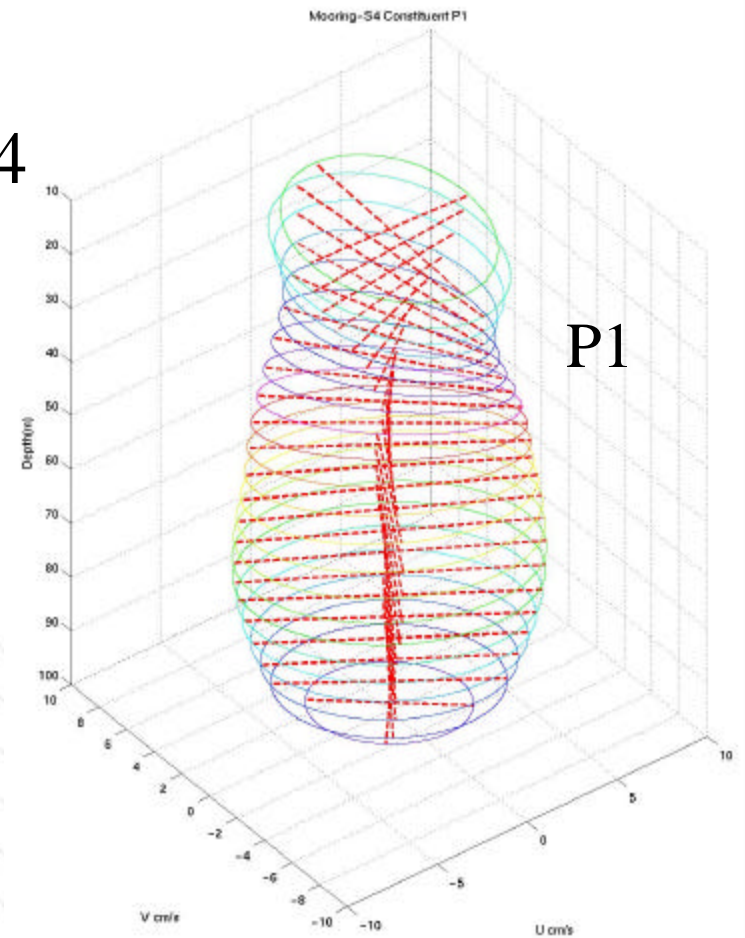
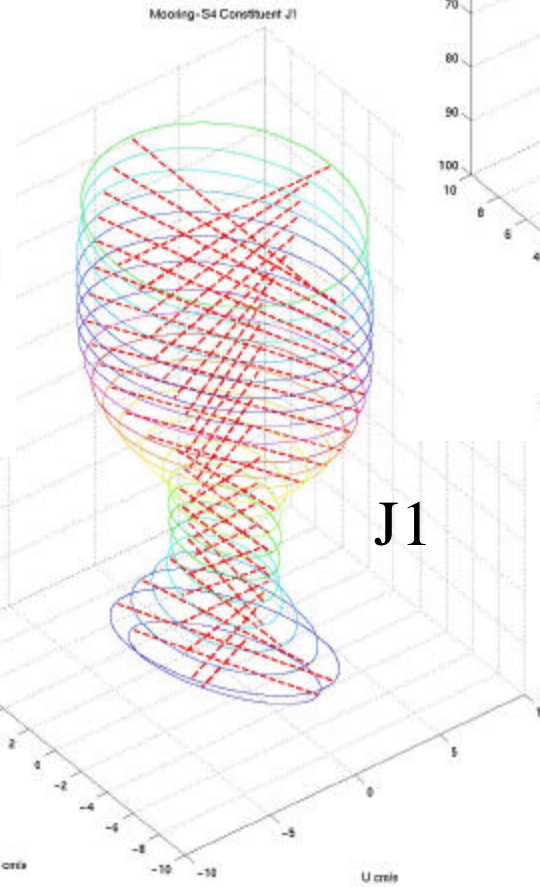
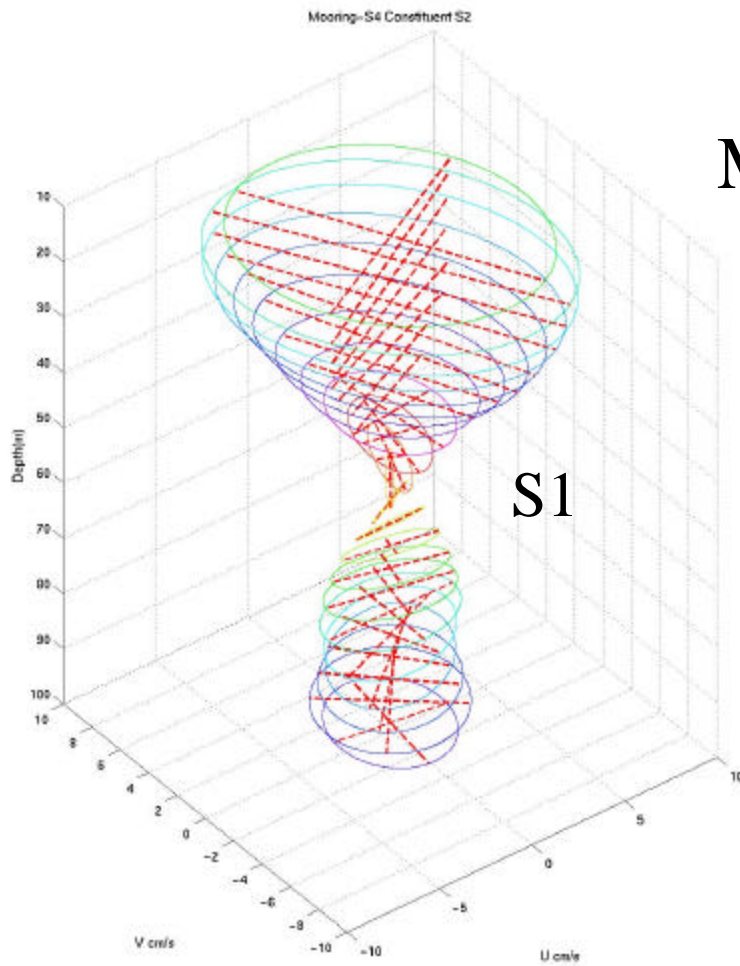
MOORING S4

(120 m Depth)



Tidal
Constituent
Ellipses

ASIAEX MOORING S4 (120 m Depth)



Tidal
Constituent
Ellipses